1966

Optimum Number, Size, and Location of Multiple Product Vegetable Processing Establishments in South Central Louisiana.

Jose Edgar Lopez
Louisiana State University and Agricultural & Mechanical College

LÓPEZ, José Edgar, 1939-
OPTIMUM NUMBER, SIZE, AND LOCATION OF MULTIPLE PRODUCT VEGETABLE PROCESSING ESTABLISHMENTS IN SOUTH CENTRAL LOUISIANA.

Louisiana State University, Ph.D., 1966
Economics, agricultural

University Microfilms, Inc., Ann Arbor, Michigan

OPTIMUM NUMBER, SIZE, AND LOCATION OF MULTIPLE PRODUCT VEGETABLE PROCESSING ESTABLISHMENTS IN SOUTH CENTRAL LOUISIANA

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Agricultural Economics
and Agribusiness

by
José Edgar López
B.S., Clemson University, 1961
M.S., The University of Georgia, 1963
May, 1966

ACKNOWLEDGMENT

The author wishes to express his most sincere appreciation to the following individuals for their assistance in this study.

To Dr. Leo Polopolus for his encouragement, guidance and assistance during the preliminary stages of this study.

To Dr. Jerry M. Law, Committee Chairman, for his guidance and assistance in the preparation of this manuscript.

To the other members of the author's advisory committee, Drs. Robert Flammang, F. H. Wiegmann, Joe R. Campbell, and Lonnie L. Fielder for their guidance, counsel and constructive criticism throughout the study.

To the Louisiana State University Computer Research Center and to Dr. Lonnie L. Fielder for his assistance in the use of this facility.

To all individuals who cooperated in supplying the necessary data for this study.

To Miss Lucille Frey and Miss Mildred Cobb for typing the manuscript.

To his parents, Luis and Marta, for encouragement and support throughout his undergraduate and graduate program. Also, to his grandmother Mercedes de Lopez y Lopez for her unending efforts and

wisdom during the completion of his professional career. And to his grand-uncle and aunt, Albert and Laura, his grandparents, Alan and Mercedes, for their advice and encouragement during the completion of the graduate program.

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ABSTRACT

This study was undertaken with the purpose of determining the optimum number, size, and location of multiple product vegetable processing establishments in South Central Louisiana for minimum assembly and processing costs. The South Central Louisiana area includes eight parishes: Acadia, Allen, Avoyelles, Evangeline, Iberia, Lafayette, St. Landry, and St. Martin. Vegetable processing operations represent an important segment of South Central Louisiana's economy. Over two-thirds of Louisiana's vegetable processing plants were located in the South Central section during the 1962-1963 season.

Data needed for the study were obtained from various sources. Vegetable production estimates were obtained primarily from a proportional stratified sample of 246 vegetable producers in the study area. Twenty-four vegetable truckers contributed data to develop transportation cost coefficients. Costs of processing vegetables were obtained directly from plant efficiency models.

Because of their economic importance, sweet potatoes, okra, and tomatoes were selected for the study. Vegetable production data revealed that sweet potatoes accounted for approximately 90 percent of the vegetable tonnage in both 1962 and 1963. Avoyelles Parish showed a marked increase in acreage and production of sweet potatoes between 1962 and 1963. There has been a shift in the location of

acreage and production of sweet potatoes from the southern half of the area to the northern half. The production of okra was concentrated in St. Martin, Lafayette, and Iberia Parishes. Acadia, Avoyelles, Evangeline and St. Landry were the leading tomato producing parishes.

An "expectational" supply model and a general multiple product model were utilized to determine the number, size, and location of multiple vegetable processing establishments to minimize assembly and processing costs.

The least square simple regression technique was used in estimating all supply functions. The supply functions for sweet potatoes and okra were found to be elastic. Supply elasticities for sweet potatoes ranged from 1.632 in Acadia Parish to 3.796 in Lafayette Parish. Okra supply elasticities ranged from 3.552 in St. Landry Parish to 4.475 in St. Martin Parish. All supply functions were found to be significantly different.

The relatively high elasticity of supply was found to be associated with the following factors: existence of contracts, below average sweet potato acreage, below average experience, and land ownership.

Optimum locational patterns and optimum allocations of raw products were studied for seven "old" processing locations and ten other processing locations with long-run projections.

Results from the study of seven "old" processing locations indicated that if one multiproduct plant was considered, Opelousas would represent the "optimum" processing location in terms of minimizing assembly and processing costs. The minimum total cost of establishing one plant at Opelousas was estimated to be $369,833. One plant location would minimize total cost.

The analyses of ten processing locations was made in order to study the possibility of determining future location sites. Selection of five new sites was made on the basis of trends in vegetable production in the area. If one plant is considered, Opelousas represents an optimum location for a three-product plant processing 72,624 tons of sweet potatoes, 10,713 tons of okra, and 1,557 tons of tomatoes. If two plants are considered, Hessmer and Opelousas represent the optimum processing locations.

The study suggests Avoyelles Parish has great potential as an important future vegetable processing location. The possibility of added vegetable supplies in that area appear good. Opelousas is expected to remain the major processing center. Future allocation of resources can be expected to vary from those projected with change in demand and supply conditions, transportation costs and other factors used in the analysis.

CHAPTER I

INTRODUCTION

Federal regional economic development programs have been implemented in the United States since 1960. The Area Redevelopment Act of 1961, the Manpower and Training Act of 1962, the Accelerated Public Works Act of 1962, the Equal Opportunity Act of 1964, plus a newly designed Rural Areas Development program in 1961, have been created to stamp out regional pockets of unemployment, underemployment, and low per capita income. The causes of regional disparity of income and employment are quite numerous, but include the effects of changes in technology, depletion of natural resources, changes in consumer demand, low level of social overhead capital,[1] closing of obsolete or unprofitable plants, and inferior resources for production processes.

The federal government's Area Redevelopment Act (ARA) was designed to establish an effective program to alleviate conditions of substantial and persistent unemployment in certain economically distressed areas. Aid to these areas is dependent on the approval

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[1]Leo Polopolus and Robert W. Williams, _Factors Influencing the Location of Manufacturing Plants in a Rural Area: South Central Louisiana_ (D.A.E. Research Report Number 324; Baton Rouge: Louisiana Agricultural Experiment Station, August 1963), p. 5. (The authors define "social overhead capital" as expenditures for education, welfare, health, highways, police and fire protection, natural resources, sanitation, and utilities.)

of the respective parish Overall Economic Development Programs (OEDP). The OEDP's of the parishes in South Central Louisiana recommended that additional vegetable processing facilities be located in the area to process available raw products. Indirect employment by producers supplying the necessary raw products would increase considerably if vegetable processing is expanded since production involves intensive labor-using enterprises.

The addition and expansion of vegetable processing facilities may be an important element in accelerating economic development in South Central Louisiana. It may utilize both agricultural products and underemployed agricultural resources, among which labor is perhaps the most significant. An industry that uses farm products as a raw material can provide a direct opportunity for off-farm employment of some excess labor and an indirect opportunity on the farm by expanding the market for agricultural products.

Purpose of the Study

The problem of area economic development deals partly with the creation of employment opportunities via expanding existing industries or developing new ones. Among the particular problems arising from "feasibility research" are those of market potential, adequacy of raw product supplies, development of plant efficiency models, excess plant capacity, optimum number, size and location of processing establishments, and the application of the feasibility criterion. The purpose of this study is to estimate the availability of raw product supplies and to determine the optimum number, size, and location of multiple vegetable processing establishments in the South Central Louisiana area.

Vegetable processing plant operators can use this information to select optimum plant locations. Extension personnel can use this analysis to help investors in making proper locational decisions for establishing processing plants. State, Federal and other agencies concerned with area economic development can utilize this information to guide resource allocation for the area as a whole.

Description of the Area

Location and Size of the Area

This study is confined to eight parishes designated as "South Central Louisiana." The eight parishes are Acadia, Allen, Avoyelles, Evangeline, Iberia, Lafayette, St. Landry, and St. Martin. The location of this area is shown in Figure 1. The total land occupied by these eight parishes is 3,486,720 acres. The area of individual parishes is as follows: Acadia, 423,680 acres; Allen, 496,000 acres; Avoyelles, 528,640 acres; Evangeline, 424,320 acres; Iberia, 376,320 acres; Lafayette, 181,120 acres; St. Landry, 595,200 acres; and St. Martin, 461,440 acres.[2]

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[2]Lonnie L. Fielder, Jr., Trends in Farm Land Acreage, Use, and Value in Louisiana, 1909-1959 (D.A.E. Circular No. 279; Baton Rouge: Louisiana Agricultural Experiment Station, February 1961), pp. 2-5.

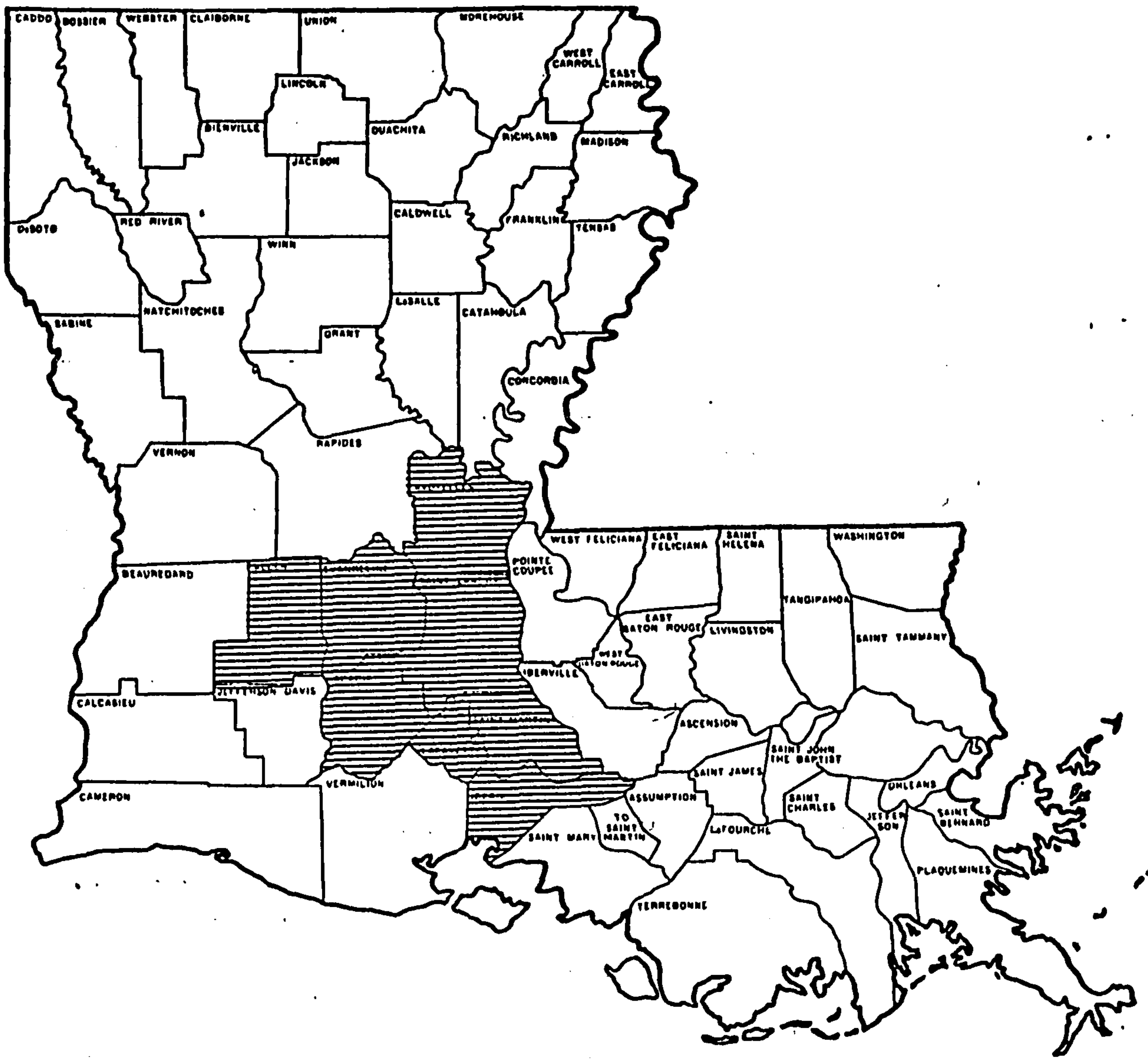

Figure 1. South Central Louisiana Defined to Include the Parishes of Acadia, Allen, Avoyelles, Evangeline, Iberia, Lafayette, St. Landry, and St. Martin.

Population

In 1960 there were 385,912 persons residing in South Central Louisiana.[3] This figure represents approximately 11 percent of the total population of the State. Census estimates indicate that the population of South Central Louisiana increased at the rate of 11.91 percent during the period 1950-1960. Over one-half of these inhabitants were residents of rural areas. The Census defines rural population to include not only farmers, but also non-farm persons residing in rural areas.

Educational Attainment

The educational attainment of South Central Louisiana's citizens is comparatively low, as shown in Table 1. The range in educational level was from 5.2 median school years in St. Martin Parish to 8.9 median school years in Lafayette Parish. All parishes except Lafayette (8.9 median years) rank below the Louisiana state level (8.8 median years).

Farm Size

Average total farm size among vegetable producers in South Central Louisiana is relatively small (i.e., 59 acres). Of this total farm acreage, an average of 11 acres is devoted to vegetable crops. The average scale of the vegetable operation varies from five

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[3]Alvin L. Bertrand, Louisiana's Human Resources, Part I, Number, Distribution, and Composition of the Population, 1960 (Bulletin Number 548; Baton Rouge: Louisiana Agricultural Experiment Station, November 1961), pp. 8-9.

Table 1. Level of Educational Attainment, Median Number of School Years Completed by Persons 25 Years of Age and Over, South Central Louisiana, 1960

Parish	Median school years completed by persons 25 years old and over
Louisiana	8.8
Acadia	6.6
Allen	7.6
Avoyelles	7.1
Evangeline	6.0
Iberia	7.5
Lafayette	8.9
St. Landry	5.9
St Martin	5.2

Source: Alvin L. Bertrand, Louisiana's Human Resources, Part I, Number, Distribution, and Composition of the Population, 1960 (Bulletin Number 548; Baton Rouge: Louisiana Agricultural Experiment Station, November 1961), pp. 23-27.

acres in Iberia Parish to 23 acres in Avoyelles Parish. While vegetable acreage accounts for only 19 percent of the total farm acreage for the area as a whole, vegetable producers in Avoyelles and Evangeline Parishes plant 32 and 25 percent, respectively, of their average total farm acreage into vegetable production.[4]

Agricultural Products

The major agricultural enterprises found in this area are cotton, sweet potatoes, corn, rice, and a variety of commercially grown vegetables. Louisiana's sweet potato industry has tended to localize in South Central Louisiana. This area produced approximately 70 percent of Louisiana's harvested acreage of sweet potatoes in 1959. Within South Central Louisiana, sweet potatoes accounted for approximately 90 percent of the vegetable acreage and 93 percent of the vegetable tonnage in both 1962 and 1963. Okra and hot peppers are the only other vegetables of major importance in South Central Louisiana. Vegetable acreage estimates for South Central Louisiana in 1963 were as follows: sweet potatoes, 45,940 acres; okra, 4,320 acres; and hot peppers, 650 acres.[5]

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[4] Leo Polopolus and Clayton L. Strebeck, _Feasibility of Additional Vegetable Processing Plants in South Central Louisiana_ (D.A.E. Research Report No. 341; Baton Rouge: Louisiana Agricultural Experiment Station, April 1965), p. 24.

[5] _Ibid._, pp. 4-5.

Number, Type, and Location of Existing Processing Plants

Fruits and vegetables were processed commercially in 21 Louisiana plants during the 1962-1963 season.[6] Two plants were operated exclusively for freezing fruits and vegetables. Products frozen included sweet potatoes, okra, strawberries, mustard greens, spinach, crowder peas, blackeyed peas, and collard greens. A third plant was utilized for the preparation and cooling of okra in large containers for further processing at other points.

The remaining 18 plants were operated totally or primarily as canners. Of these, 10 were used for canning only sweet potatoes. Five plants were used for canning sweet potatoes and one or more other items including okra, okra mixtures, dry beans, and tomatoes. Although operated primarily as a canner, one of these five plants included freezing facilities. Three plants were utilized for canning okra and/or pepper products and other specialty items.

Louisiana's fruit and vegetable processing operations are concentrated largely in the South Central section. There are fifteen plants located within South Central Louisiana. Canned sweet potatoes, okra, okra mixtures, hot peppers, and hot pepper mixtures are the leading processing products of the area.

Sources of Data

Data needed to determine the optimum number, size, and location of vegetable processing plants included the location and production

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[6] Jerry M. Law and Andrew C. Hudson, Commercial Fruit and Vegetable Processing Operations in Louisiana, 1962-1963 (D.A.E. Research Report Number 330; Baton Rouge: Louisiana Agricultural Experiment Station, November 1963), pp. 2-3.

density of the raw product to be processed, the location of potential plant sites, the transportation cost coefficients from each production point to each processing site, and processing costs.

Information regarding 1962-1963 vegetable production was obtained from a proportional stratified random sample of 246 vegetable producers in South Central Louisiana. Transportation cost coefficients were computed from a sample of 24 truckers of fresh vegetables in the study area. Potential plant sites represented locations chosen to represent the major geographic areas of South Central Louisiana. Processing costs represent data from plant efficiency models for vegetable processing. Most of the essential data to solve the problem was generated from original survey sources. Suitable data for plant location analysis was not available from official reporting agencies.

Method of Study

This study involves a partial application of the research framework for determining economic feasibility as presented by Polopolus.[7]

An "expectational supply" model was used for estimating raw product supplies. Details of this model are presented in Chapter II. Expected supply responses of individual producers were aggregated for each commodity considered.

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[7]Leo Polopolus, "A Semi-Theoretical Framework for Determining the Feasibility of Establishing Processing Facilities in a Given Area," Proceedings, Association of Southern Agricultural Workers, Inc., Atlanta, Georgia, February 1964, pp. 235-236.

The important questions of how many plants, what size(s), and location(s) were answered with the aid of a model developed originally for mono-product processing by Stollsteimer.[8] Basically, the model attempts to determine the optimum number, size, and location of plants that minimize combined raw product assembly and processing costs. The Stollsteimer model has been generalized to permit multiple product processing. The problem becomes one of determining the number, size, and location of facilities that will minimize the combined cost of assembling and processing the raw products considered. Processing cost coefficients were obtained from economic engineering studies.[9]

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[8] John F. Stollsteimer, "A Working Model of Plant Numbers and Locations," *Journal of Farm Economics*, Vol. 45, August 1963, pp. 631-645.

[9] Polopolus and Strebeck, *op. cit.*, pp. 27-58.

CHAPTER II

THEORETICAL FRAMEWORK

The framework employs an expectational supply model and a multiple product model to determine the optimum number, size and location of plants in South Central Louisiana. These models are discussed and formulated below.

The Expectational Supply Model

The supply curve shows the maximum quantities of a commodity per unit of time which producers will place on the market at various prices. Usually the supply curve will be upward sloping to the right, since a higher price will induce producers to place more of the good on the market and may induce additional producers to come into the field.

The formula for numerical measurement of elasticity of supply is described as follows:

$$(1)\ Ns = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}}$$

Where Ns is elasticity of supply, ΔQ is the change in quantity supplied, Q is the quantity supplied, ΔP is the change in price and P is the price.[1]

Supply elasticities will be determined via "expectational" supply models, rather than by using either positive or normative approaches.[2] The model is called "expectational" because it refers to how producers expect to behave rather than how they did behave or how they should behave. Determining producer responsiveness to price changes is most important as a guide to projecting the availability of future raw product supplies. Positive analysis involves the estimation of quantitative relationships of relevant variables as they exist at a point in time (or have existed over a period of time). Normative supply analysis refers to what ought to exist, normally under certain optimizing assumptions.

The expectational supply model calls for individual producer supply schedules to be developed from a random sample of respondents. A supply schedule is obtained for each relevant commodity produced by the respondent. The individual commodity supply schedule involves a set of price-quantity responses. The values of expected production are given for various and corresponding values of price. Expected

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[1]Richard H. Leftwich, The Price System and Resource Allocation, New York: Holt, Rinehart and Winston, 1961, p. 46.

[2]Leo Polopolus, "A Semi-Theoretical Framework for Determining the Feasibility of Establishing Processing Facilities in a Given Area," Proceedings, Association of Southern Agricultural Workers, Inc., Atlanta, Georgia, February 1964, pp. 235-236.

price-quantity data are recorded for levels above and below the current mean price level. If certain current mean prices are common to a large group of producers, a simple (horizontal) aggregation of expected production is possible. However, if current mean prices are uncommon among producers, the aggregation for the producers of a common mean price is obtained as explained above. Secondly, simple regression equations are fitted to the various supply schedules so obtained.

Assuming n supply equations for a particular commodity, the i^{th} equation may be stated as:

(2) $P_i = \hat{a}_i + \hat{b}_i Q_i$

where P_i represents price and Q_i the corresponding and expected production; $\hat{a}_i$ and $\hat{b}_i$ are the estimated parameters.

Given the estimated parameters for the n supply equations of a given commodity, the aggregate commodity supply equation is derived as follows:

(3) $Q_i = -\frac{\hat{a}_i}{\hat{b}_i} + \frac{1}{\hat{b}_i} P_i$

let: $a_i' = -\frac{\hat{a}_i'}{\hat{b}_i}$ and $b_i' = \frac{1}{\hat{b}_i}$

Therefore,

(4) $Q_i = a_i' + b_i' P_i$

Summing over Q for given values of P,

$$(5) \quad \sum_{i=1}^{n} Q_i = \sum_{i=1}^{n} a_i' + P_k \sum_{i=1}^{n} b_i'$$

Letting $Q_i' = \sum_{i=1}^{n} Q_i'$,

$$(6) \quad P_k = \frac{\Sigma a_i'}{\Sigma b_i'} + \frac{1}{\Sigma b_i'} Q_i'$$

Re-substituting the parametric estimates,

$$(7) \quad P_k = \frac{\sum_{i=1}^{n} \frac{\hat{a}_i}{\hat{b}_i}}{\sum_{i=1}^{n} \frac{1}{\hat{b}_i}} + \frac{1}{\sum_{i=1}^{n} \frac{1}{\hat{b}_i}} Q_i'$$

Supply elasticity is determined by fitting simple linear regression equations to the various supply schedules obtained. Mean supply elasticity for this purpose, is obtained for each vegetable commodity for the relevant areas of production. The standard formula can be described as follows:

$$(8) \quad Ns = \frac{1}{b_i} \cdot \frac{\bar{P}_i}{\bar{Q}_i}$$

where Ns_i represents the mean elasticity of supply, b_i represents the slope of the supply function ($\sum_{i=1}^{n} \frac{1}{b_i}$ in equation 7), $\overline{P_i}$ represents the average price of the product and $\overline{Q}_i$ the corresponding average and expected production of the commodity in question. Mean elasticity coefficients are computed with the standard formula for individual and aggregate supply areas.

Statistical Tests for Supply Functions

Often it is necessary to know if it is possible to pool several samples or groups of data into one large sample. The simple linear supply functions can be tested statistically when dealing with regression analysis. The tests reveal whether one regression equation can be used for all of the observations.

The supply functions are tested to see if the individual functions computed for the various producing areas can be combined into a single supply function appropriate for the entire producing area. Two statistical tests are performed. The first test determines whether one regression of the usual form can be fitted to all observations. To make this test it is necessary to compute (1) the mean square of the difference in the sum of squares of deviations from regression of all observations and the sum of squares of pooled deviations for each producing area and (2) the mean square of the pooled sum of squares.

The second test made is to determine if the regression coefficient for each producing area estimates the same population regression coefficient. That is, do the supply curves in different producing areas have the same slope? If so, the same regression coefficient can be used for all producing areas. To resolve this question, it is necessary to compute (1) the mean square of the difference in the sum of squares of the deviations from a regression fitted to the pooled sum of squares and (2) the sum of squares of deviations from regressions fitted to the data for each producing area, and the mean squares of the latter sum of squares.[3]

The General Multiple Product Model

Stollsteimer's "Working Model for Plant Numbers and Locations" considers the problem of simultaneously determining the number, size, and location of plants that minimize the combined transportation and processing costs involved in assembling and processing any given quantity of raw materials produced in varying amounts at scattered production points. While the problem considered is of limited scope in the sense that only a single raw material is considered, and the model developed does not yield a system that simultaneously minimizes assembly, processing and distribution costs, the procedures presented do appear to be applicable to a fairly wide range of problems in the general area of plant location.[4] The model can be somewhat "generalized" in order to permit multiple product processing.[5] The assumption

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[3]Bernard Ostle, Statistics in Research, Ames: Iowa State University Press, 1963, pp. 201-205.

[4]John F. Stollsteimer, "A Working Model of Plant Numbers and Locations," Journal of Farm Economics, Vol. 45, August 1963, p. 632.

[5]Leo Polopolus, "Optimum Plant Numbers and Locations for Multiple Product Processing," Journal of Farm Economics, Vol. 47, May 1965, pp. 287-295.

that economies of scale in plant operations with plant costs independent of plat locations will be incorporated into the model. The various products are permitted to be processed sequentially or simultaneously. However, it is assumed that the multiple products are formed from separate raw products and that each processed product is represented by one of these raw materials.

The standard formulation of the general multiple product model is described as follows:

Given:

I = raw material areas or sites

M = raw materials

L = potential processing locations

J = number of processing plants

Q_{mi} = quantity of raw material m produced in area i

The problem is one of determining the number, size, and location of facilities that will minimize the combined cost of assembling and processing the m raw product produced in the region. Algebraically, this may be stated as follows: <u>Minimize:</u>

$$(1)\quad \underset{(J,L_k)}{TC} = \sum_{m=1}^{M} \sum_{j=1}^{J} C_{mj} Q_{mj} \mid L_k + \sum_{m=1}^{M} \sum_{i=1}^{I} \sum_{j=1}^{J} Q_{mij} T_{mij} \mid L_k$$

With respect to plant numbers ($J \leq L$) and locational pattern

$L_k = 1 \ldots \binom{L}{J}$ subject to:[2]

$$\sum_{j=1}^{J} Q_{mij} = Q_{mi} = \text{quantity of raw material } m \text{ available at origin } i$$
per production period.

$$\sum_{i=1}^{I} Q_{mij} = Q_{mj} = \text{quantity of raw material } m \text{ processed at plant } j$$
per production period.

$$\sum_{i=1}^{I} \sum_{j=1}^{J} Q_{mij} = Q_{m} = \text{total quantity of raw material } m \text{ produced and}$$
processed per production period.

$$\sum_{m=1}^{M} \sum_{i=1}^{I} \sum_{j=1}^{J} Q_{mij} = Q = \text{total quantity of raw materials produced}$$
and processed per production period (in standardized units)

$$Q_{mij},\ Q_{mj},\ Q_{mi} \geq 0 \text{ and } T_{mij} > 0$$

In the above:

TC = total processing and assembly cost.

C_{mj} = unit processing cost of product m in plant j ($j=1 \ldots J \leq L$) located at L . (Joint processing costs are assumed to be appropriately deducted from any combination of m products to avoid double counting.)

Q_{mij} = quantity of raw material m shipped from origin i to plant j located at L_j.

T_{mij} = unit cost of shipping raw material m from origin i to plant j located at L_j. (Joint assembly costs are assumed to be appropriately deducted from any combination of m raw products to avoid double counting.)

L_k = one locational pattern for J plants among the $\binom{L}{J}$ possible combinations of locations for J plants given L possible locations.

L_j = a specific location for an individual plant ($j=1 \ldots J$).

Long-run plant costs are assumed to be independent of plant location. At each location and for each product, the form of the long-run plant-cost function is assumed to be linear with respect to output. It is also assumed that the function has a positive intercept. For a given product the long-run cost function will involve equal factor costs at all potential locations. Unit costs are assumed to be a function of plant size.

It should be noted that the aggregate processing cost at any given location is merely the sum of the individual product processing costs, with an appropriate deduction for the joint costs of processing. Similarly, the aggregate cost of assembling the various raw products at a particular plant location is calculated by summing the individual assembly costs and subtracting the joint costs of assembly. Joint costs are defined to involve situations where identical productive inputs are utilized for two or more products. For example, sequentially processing two different products gives rise to joint costs if a particular input is required to process both products. Simultaneously processing the same two products with a given productive input is impossible (unless a combination or joint pack is involved), and, therefore, does not result in joint costs.

As with the Stollsteimer model, the problem of minimizing equation (1) with respect to plant numbers (J) and location pattern (L_k) can be accomplished in two basic steps. The first step is to obtain a transfer cost function that has been minimized with respect to plant locations with varying numbers of plants for each product. For each possible locational pattern, L_k, there is a sub-matrix, $T_{mij}^* \mid L_k$, of the transportation cost matrix T_{mij}. This sub-matrix will be I x J with the entries in each of the J columns representing the transfer costs of product m from each origin to a particular plant site. A 1 x I vector $\overline{T_{mij}} \mid L_k$ is obtained by scanning $T_{mij}^* \mid L_k$ by rows and selecting the minimum T_{ij} in each row.

Minimum total transfer costs of product m with J plants is a specified set of locations L_k is equal to the vector Q_m' (whose entries Q_{mi} represent the quantities of material m produced at each of the I origins) multiplied by the vector $\overline{T_{mij}} \mid L_k$. For a particular product the minimum of these values over L_k is a point on the transfer cost function minimized with respect to plant location.

The minimized assembly costs of the m raw products are then aggregated with regard for plant numbers and locational pattern. It is important to point out that the minimized total assembly cost function representing m products is not usually a simple summation of the individual product assembly costs because different locational patterns become optimum as the product dimension is increased.

The second major step in the procedure involves the addition of the minimized total assembly and processing costs, where both assembly and processing costs are functions of plant numbers.

"Minimized" processing costs are peculiarly defined to involve only the intercept values of linear processing cost equations. Assuming m products, "minimum" processing costs, TPC, would be the sum of m intercept values, a, minus the joint processing costs, JPC, involving m products.

$$\text{(a)} \quad TPC_{A,\, B,\, \ldots\, M} = a_A = a_B + \ldots + a_M - JPC_{A,B,} \ldots M.$$

If, in solving the minimization problem, it is concluded that two or more processing locations are necessary to minimize overall assembly and processing costs, adjustments in the joint cost calculations may be required for particular locations. For example, assume that locational pattern 1 and 2 is optimum for processing raw products A, B, and C. Assume further that the optimizing solution suggests that a certain quantity of A and all of B be processed at Location 1, while the balance of raw product A and all of C should be processed at Location 2. Joint costs involving the processing of all three products would be inappropriate. Obviously, for Location 1:

$$\text{(3)} \quad TPC_{A,B} = a_A + a_B - JPC_{A,B}$$ and for

Location 2:

$$\text{(4)} \quad TPC_{A,C} = a_A + a_C - JPC_{A,C}$$

Thus, "minimum" total processing costs would vary with the number of plants as well as with the combination of products handled in each plant.

Expectational Supply and Plant Location

The producer responsiveness to price changes is obtained from the expectational supply model. Supply elasticities give the relevant changes in quantity that are obtained from a given change in price. The effect of a price change upon plant location can be evaluated by incorporating the corresponding levels of production into the model.

Thus, a comparison of the locational patterns given certain levels of price increase and/or decrease can be made. Since each area of production may differ in its price responsiveness, there may be locational changes as prices change in the future. It is intended that investigation of these relationships be conducted in order to evaluate the usefulness of expectational estimates in determining the optimum number, size, and location of multiple product processing plants.

A Hypothetical Illustration

A hypothetical illustration demonstrates the operation of the overall technique. For the sake of simplicity let us assume two processed products, four points of raw product origin and four potential plant locations. Raw material A is produced in each region or vector $Q_A' = (25, 42, 60, 75)$. Raw material B is not produced in region 1 Vector $Q_B' = (0, 50, 70, 35)$. Thus, there is a total of 357 standardized units of raw product (202 of A and 155 of B) available for processing. Transfer cost coefficients per unit of raw product are shown in Table 2.

Table 2. Hypothetical Raw Product Transfer Costs, T_{mij}'s, Raw Products A and B, per Unit Basis

Origin of Raw Products	Potential Plant Location 1 A	1 B	2 A	2 B	3 A	3 B	4 A	4 B
	- - - - - -	-	Transfer costs per unit	-	-	-	-	-
1	2	3	1	4	1	5	2	5
2	5	2	3	2	5	2	3	3
3	2	2	1	4	1	3	1	1
4	1	1	2	3	3	4	1	2

<u>Assembly Costs -- One Plant Considered</u>

With J, the number of plants, equal to one, there are four possible plant locations.

$$[\ {}_{L}C_{J} = {}_{4}C_{1} = \frac{4!}{1!\,(4-1)!} = 4\ ]$$

The vector C_{Aij} for each L_k is simply one of the columns of the matrix C_{Aij}. Thus, total transfer cost of raw product A for each potential plant location, L_k, is equal to the vector X_A' multiplied by the appropriate column of the matrix C_{Aij}. For raw product A and plant location 1:

$$TTC_A = (25,\ 42,\ 60,\ 75) \cdot \begin{bmatrix} 2 \\ 5 \\ 2 \\ 1 \end{bmatrix} = 455$$

For location 2, $TTC_A = 361$

For location 3, $TTC_A = 520$

For location 4, $TTC_A = 311$

Thus, total transfer costs of raw product A are at a minimum with a single plant at location 4.

For raw product B and plant location 1,

$$TTC_A = (0,\ 50,\ 70,\ 35) \cdot \begin{bmatrix} 3 \\ 2 \\ 2 \\ 1 \end{bmatrix} = 275$$

For location 2, $TTC_B = 485$

For location 3, $TTC_B = 450$

For location 4, $TTC_B = 310$

The combined "gross" assembly cost of the two raw products ($TTC_A + TTC_B$), disregarding joint costs is as follows:

For location 1: 455 + 275 = 730

For location 2: 361 + 485 = 846

For location 3: 520 + 450 = 970

For location 4: 311 + 310 = 621

Assuming that 10 percent of the cost of assembling the raw product was jointly incurred, the total "net" assembly cost to deliver A and B to each of the four plant locations is as follows: [6]

For location 1: 730 - 73.0 = 657.0

For location 2: 846 - 84.6 = 761.4

For location 3: 970 - 97.0 = 873.0

For location 4: 621 - 62.1 = 558.9

Thus, location 4 minimizes the total net transfer costs for the two raw products, A and B. Any other plant selection would increase

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[6]The assignment of joint assembly costs at a 10 percent level is arbitrary for this example. The appropriate level of joint assembly costs, if any, would depend upon the particular problem at hand.

overall transfer costs. It is assumed that joint transfer costs are independent of plant location.

Assembly Costs -- Two Plants Considered

When two plants are permitted to be established, there are six possible combinations of locations $[{}_4C_2 = \frac{4!}{2!\ (4-2)!} = 6]$

The two plants meeting the optimum requirements will process products A and B.

First, let us consider one of the six possible combinations, locations 1 and 2. For product A a vector of minimized unit transfer costs is obtained by scanning the first two columns of C_{Aij} and selecting the minimum element in each row. This yields the following vector:

$$\overline{C_{Aij}} \mid L_k = \begin{bmatrix} 1 \\ 3 \\ 1 \\ 1 \end{bmatrix}$$

Multiplying this vector by (X''_A) yields minimum total transfer costs for product A, given two plants located at sites 1 and 2.

$$(X''_A) \ (\overline{C_{Aij}} \mid L_k) = 25,\ 42,\ 60,\ 75 \begin{bmatrix} 1 \\ 3 \\ 1 \\ 1 \end{bmatrix} = 286$$

By applying the same procedure, total minimum transfer cost can be determined for the other combinations of product A and also for product B. The minimum total gross transfer costs for products A and B and the minimum total "net" transfer costs for the six combinations of location are shown in Table 3.

Table 3. Gross Minimum Transfer Cost, Total Joint Costs and Net Minimum Transfer Cost for Six Locational Patterns for Raw Products A and B

Locations	Gross minimum transfer cost A	Gross minimum transfer cost B	Total cost	Total joint costs (at 10 percent)	Net minimum transfer cost
1,2	286	275	561	56.1	504.9
1,3	370	275	645	64.5	580.5
1,4	311	205	516	51.6	464.4
2,3	361	415	776	77.6	689.4
2,4	286	240	526	52.6	473.4
3,4	286	240	526	52.6	473.4

Thus, when two plants are considered, the locational pattern of plants 1 and 4 minimize the cost of assembling raw products A and B.

Optimum Allocation of Raw Materials A and B

The process of minimizing the assembly cost of raw product also enables us to determine the allocation of the various raw products to the various plant locations. Continuing the hypothetical example, raw products A and B are allocated from the origins of production to processing locations as shown in Table 4.

If only one product is considered, the 202 units of A and 155 units of B are processed in plant number 4. When two plants are considered, plant number 1 would process 100 units of A and 85 units of B -- the balance of the raw materials being processed by plant number 4.

Table 4. Optimum Allocation of Raw Materials A and B Available for Processing Under Various Locational Situations[1/]

Number of plants considered	Optimum locational pattern Plant number(s)	Minimum assembly costs (dollars)	Standardized units of product A	B	Total
1	4	558.9	202	155	357
2	1	464.4	100	85	185
	4		102	70	172
Subtotal			202	155	357
3	1	441.9	75	35	110
	2		25	50	75
	4		102	70	172
Subtotal			202	155	357
4	1	441.9	75	35	110
	2		60	50	110
	3		25	--	25
	4		42	70	112
Subtotal			202	155	357

1/ Slight modifications of the results of Table 4 will also provide an optimum allocation of raw products A and B consistent with our minimization criteria. It is assumed, however, that in a real empirical problem the optimum allocation will be single valued.

Processing Costs

For a given locational pattern minimum total processing costs are defined as the sum of the processing costs of each product, minus joint processing costs.

As plant numbers are permitted to increase, total processing costs will increase more than proportionately. That is, when multi-product processing and a fixed volume of raw supplies are assumed, costs will increase by more than the value of the intercept of the processing cost function as plant numbers increase (see Figure 2). While the intercept value is roughly interpreted as the minimum average long-run cost of establishing and maintaining a plant, it is assumed

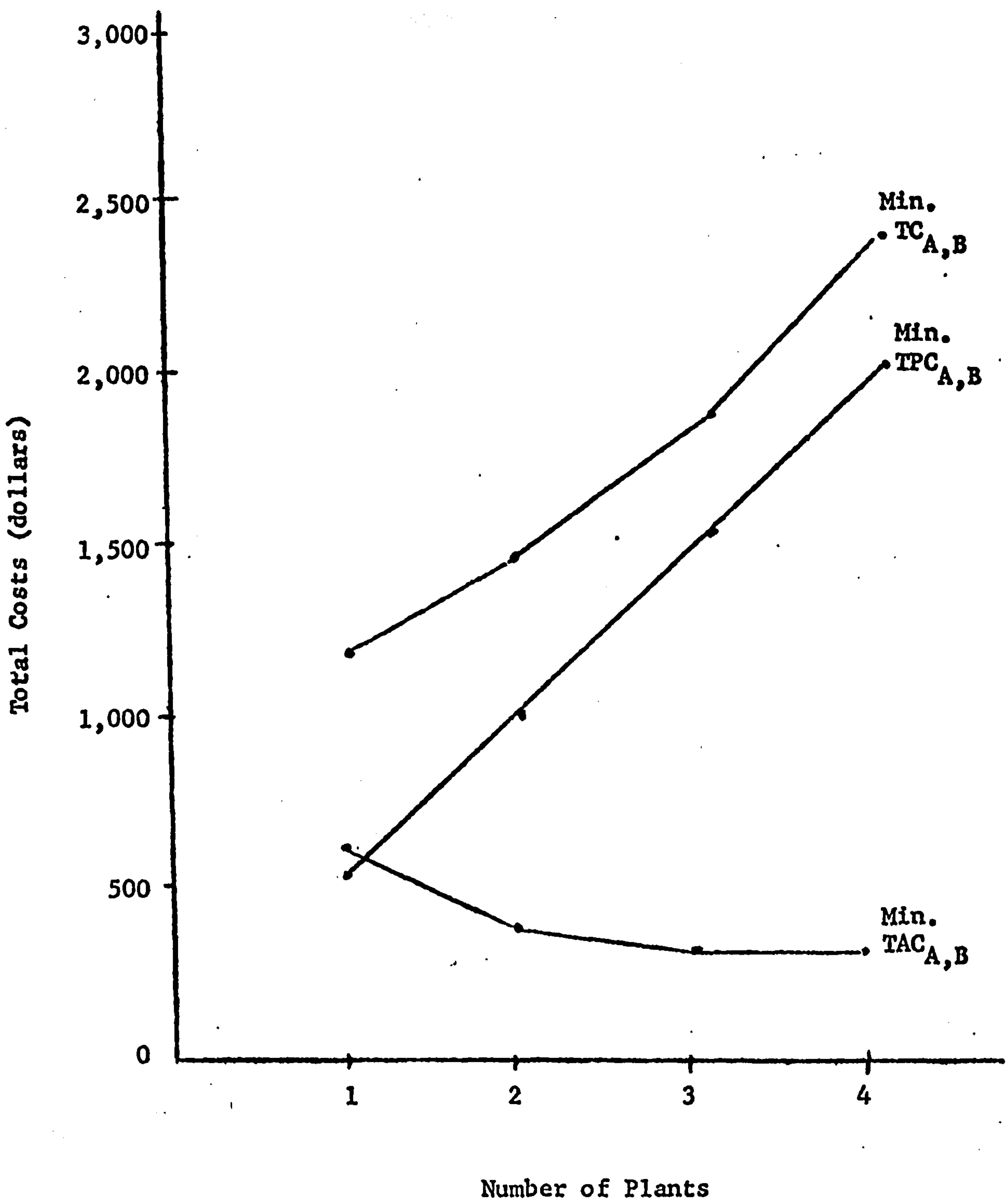

Figure 2. Minimized Total Assembly and Processing Costs, Raw Products A and B Handled and Processed Jointly.

that this long-run cost increases with increasing plant numbers. Why? Because with fixed quantities of raw materials to be processed, it is expected that joint processing costs become less effective as plant numbers increase.

Combined Assembly and Processing Costs

As with monoproduct processing, the addition of the minimized total assembly costs and processing costs with varying numbers of plants yields a total cost function minimized with respect to locations of varying numbers of plants. The number of plants that minimize combined assembly and processing costs depends upon the relative slopes of the minimized total assembly cost, $TAC_{A, B}$, and total processing cost, $TPC_{A, B}$, functions.

CHAPTER III

ANALYSIS OF SUPPLY RESPONSE

A variety of vegetables is produced in South Central Louisiana. The data utilized for analysis of commodity supply response originated from the proportional stratified sample of vegetable growers interviewed in the area during August and September of 1963.[1] The interview schedule used in obtaining supply estimates is presented in Appendix B.

Available Raw Product Supplies

The available acreage and production of vegetables in South Central Louisiana is presented in Tables 5 and 6, respectively. Sweet potatoes accounted for approximately 90 percent of the vegetable tonnage in both 1962 and 1963. The northern-most parish, Avoyelles, accounted for 30 percent of the area's sweet potato acreage and 39 percent of the total production in 1963. Okra acreage increased noticeably in St. Landry Parish in the 1962-63 period, but poor weather conditions led to decreased production in 1963.

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[1]The sample represented 5 percent of the population of vegetable growers in the area as determined by the 1959 U. S. Census of Agriculture. The number of respondents for parishes was determined according to the population percentage.

Table 5. Vegetable Acreage, South Central Louisiana, by Parishes, 1962-1963

Parish	Sweet potatoes 1962	Sweet potatoes 1963	Okra 1962	Okra 1963	Hot peppers[a] 1962	Hot peppers[a] 1963	Others[b] 1962	Others[b] 1963	Total 1962	Total 1963
	- - - -	- - - -	- - - -	- - - -	- - - -	-Acres-	- - - -	- - - -	- - - -	- - - -
Acadia	5,240	4,360	-	10	-	-	-	-	5,240	4,370
Allen	180	640	-	-	-	-	-	-	180	640
Avoyelles	12,420	14,020	-	-	-	-	-	-	12,420	14,020
Evangeline	10,020	10,360	-	-	-	-	-	20	10,020	10,380
Iberia	-	-	550	480	160	300	-	20	710	800
Lafayette	4,500	2,340	1,200	1,080	80	50	-	-	5,780	3,470
St. Landry	13,880	12,160	625	1,000	-	-	20	100	14,525	12,260
St. Martin	2,720	2,060	1,775	1,750	300	300	100	180	4,895	4,290
Area Total	48,960	45,940	4,150	4,320	540	650	120	320	53,770	51,230

a/ Excludes acreages of grower-processors.

b/ Includes cabbage, squash, Irish potatoes, sweet corn, and tomatoes.

Table 6. Vegetable Production, South Central Louisiana, by Parishes, 1962-1963

Parish	Sweet potatoes		Okra		Hot peppers[a]		Others[b]		Total	
	1962	1963	1962	1963	1962	1963	1962	1963	1962	1963
	-Tons-									
Acadia	15,053	14,013	-	-	-	-	-	-	15,053	14,013
Allen	650	3,675	-	-	-	-	-	-	650	3,675
Avoyelles	54,202	65,360	-	-	-	-	-	-	54,202	65,360
Evangeline	41,300	37,368	-	-	-	-	-	40	41,300	37,408
Iberia	-	-	1,530	1,130	244	308	-	5	1,774	1,443
Lafayette	13,165	6,258	2,925	2,220	100	50	-	-	16,190	8,528
St. Landry	34,616	30,924	1,600	460	-	-	120	470	36,336	31,854
St. Martin	7,288	7,500	4,475	4,550	900	1,030	340	580	13,003	13,660
Area Total	166,274	165,098	10,530	8,360	1,244	1,388	460	1,095	178,508	175,941

a/ Excludes production of grower-processors.

b/ Includes cabbage, squash, Irish potatoes, sweet corn, and tomatoes.

Densities of Vegetable Acreage and Production

The ward unit was utilized to determine the most important areas of vegetable production. The producing areas were identified by a town representing the normal delivery or assembly point. The 25 areas with their respective parishes and wards are identified in Table 7. Figure 3 represents the local farm assembly points for South Central Louisiana. The producing origins are designated by their normal assembly points. For example, the producing origins in Avoyelles Parish are Marksville, Hessmer, Mansura, Cottonport and Bunkie.

Tables 8 and 9 present the acreage and production of sweet potatoes and okra according to market outlet and production origin for South Central Louisiana, 1962-1963.

Of the total sweet potato production in South Central Louisiana, approximately one-third is marketed in processing outlets. Some of the producing areas, however, have traditionally supplied a large portion of total production for canning purposes. At least one-half of the production in the Breaux Bridge, Carencro, Point Blue, Church Point, Lafayette, Oberlin, and Ville Platte producing origins entered processing outlets in 1963.

The production of okra is concentrated in St. Martin, Lafayette, and Iberia Parishes. These three parishes accounted for 77 percent of the acreage and 94 percent of the production in 1963. The Arnaudville, Breaux Bridge, and St. Martinville producing origins provided 54 percent of the total production in 1963. Other prominent producing

Table 7. The Production Origins, South Central Louisiana

Identification number	Assembly point	Parish	Official ward number(s)
1	Arnaudville	St. Martin	5
2	Branch	Acadia	2
3	Breaux Bridge	St. Martin	4
4	Bunkie	Avoyelles	10
5	Carencro	Lafayette	6
6	Point Blue	Evangeline	1 a/
7	Church Point	Acadia	3
8	Cottonport	Avoyelles	8, 9
9	Delcambre	Iberia	7, 9
10	Hessmer	Avoyelles	4, 5
11	Lafayette	Lafayette	3, 4, 9
12	Lawtell	St. Landry	6
13	Leonville	St. Landry	3
14	Loreauville	Iberia	4
15	Mansura	Avoyelles	3, 6
16	Marksville	Avoyelles	2
17	New Iberia	Iberia	5, 6, 8
18	Oakdale	Allen	4, 5
19	Oberlin	Allen	1
20	Opelousas	St. Landry	1, 4
21	Osson	Lafayette	1
22	Scott	Lafayette	2, 8
23	St. Martinville	St. Martin	1, 3
24	Sunset	St. Landry	2
25	Ville Platte	Evangeline	1, 3, 5

a/ Acreage and production are defined as 20 percent of the ward total; the balance is allocated to producing origin Number 25.

origins are Lafayette, New Iberia, Carencro, and Sunset. Approximately 97 percent of South Central Louisiana's okra production is sold to canning and freezing plants. The minor sales of okra to fresh market outlets usually occur at the beginning of the processing season -- a time when fresh okra prices are relatively more attractive than processor prices.

Table 8. Acreage and Production of Sweet Potatoes, Fresh and Processing Market Outlets, by Production Origins, South Central Louisiana[a]

Production origin	Fresh acreage		Processing acreage		Fresh production		Processing production		Total production	
	1962	1963	1962	1963	1962	1963	1962	1963	1962	1963
	- - - - - - - - Acres- - - - - -				- - - - - - - - - - - - Tons- - - - - - - - - - - - - -					
Arnaudville	1,260	980	960	860	3,484	3,087	2,654	2,709	6,138	5,796
Branch	1,680	860	180	800	6,225	2,967	667	2,760	6,892	5,727
Breaux Bridge	200	80	200	80	570	350	570	350	1,140	700
Carencro	360	400	520	420	1,526	1,310	2,205	1,376	3,731	2,686
Point Blue	824	824	868	952	3,244	2,791	3,418	3,225	6,662	6,016
Church Point	1,780	860	1,160	1,640	4,366	2,382	2,845	4,543	7,211	6,925
Cottonport	2,020	1,820	1,180	1,080	7,680	8,525	6,283	6,225	13,963	14,750
Hessmer	5,300	6,560	1,180	1,300	24,329	29,228	5,441	5,878	29,770	35,106
Lafayette	320	160	940	700	1,466	755	3,898	2,454	5,364	3,209
Lawtell	2,480	2,260	580	720	6,870	6,373	1,606	2,031	8,476	8,404
Leonville	1,220	860	600	460	3,361	2,440	1,653	1,305	5,014	3,745
Mansura	1,600	1,700	180	380	5,929	6,464	737	1,573	6,666	8,037
Marksville	960	1,180	0	0	3,600	4,425	0	0	3,600	4,425
Oakdale	60	200	40	0	263	1,033	188	0	451	1,033
Oberlin	40	200	40	200	75	1,125	75	1,125	150	2,250
Opelousas	4,320	3,040	860	1,320	9,519	6,817	2,023	2,960	11,542	9,777
Osson	1,220	460	880	180	6,058	2,033	4,369	796	10,427	2,829
Scott	60	20	60	0	375	12	375	0	750	12
St. Martinville	20	0	80	60	58	0	230	75	288	75
Sunset	1,420	1,660	1,280	1,240	5,350	6,557	4,822	4,898	10,172	11,455
Ville Platte	3,976	3,956	4,352	4,628	15,445	13,218	16,733	15,365	32,178	28,583
Total	31,120	28,080	16,140	17,020	109,793	101,892	60,792	59,648	170,585	161,540

a/ Acreage and production of sweet potatoes were not reported in the producing origins not shown in the table.

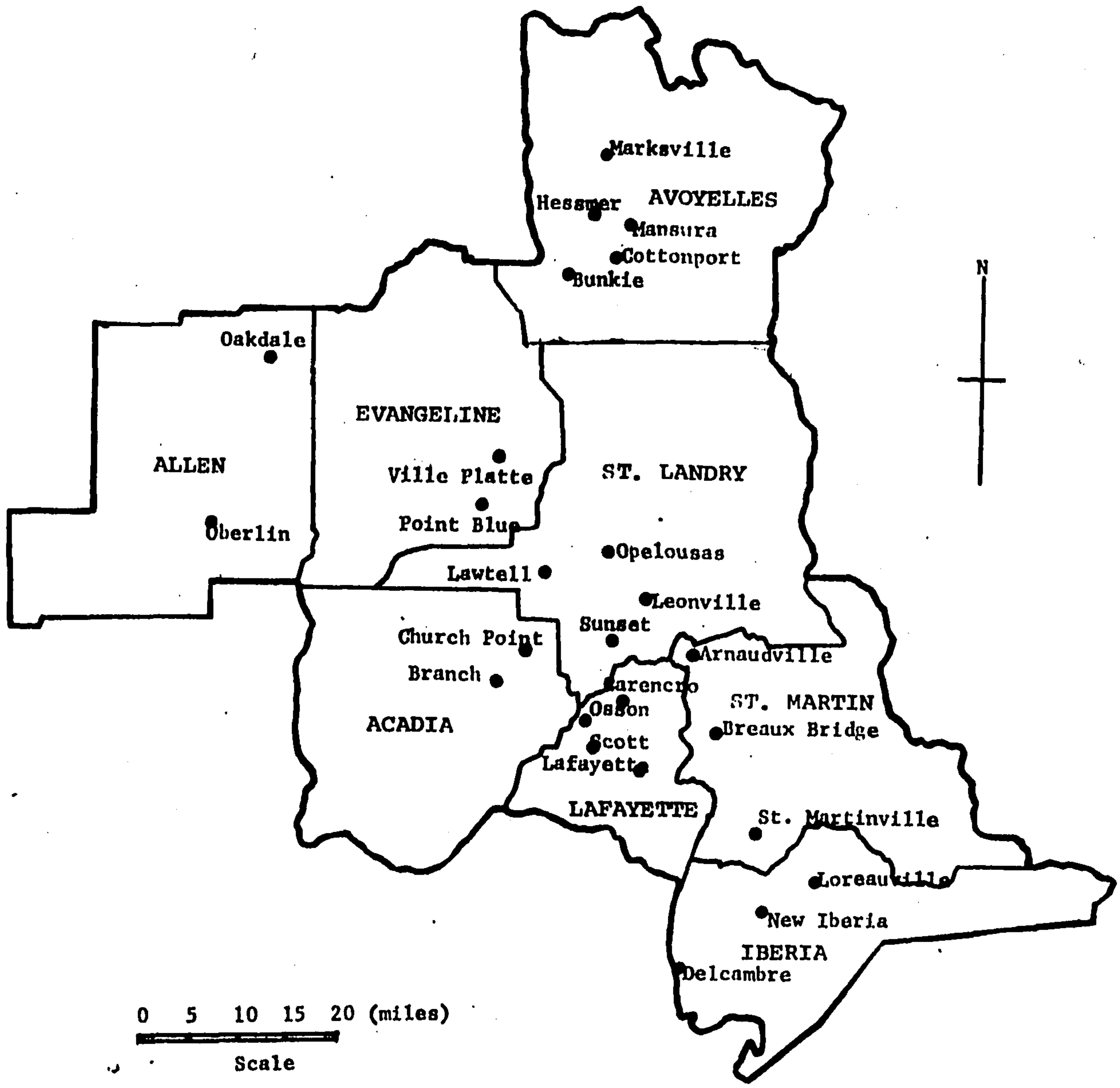

Figure 3. Local Farm Assembly Points, South Central Louisiana.

Table 9. Acreage and Production of Okra, Processing Market Outlets, by Production Origins, South Central Louisiana a/

Production origin	Processing acreage 1962	Processing acreage 1963	Processing production 1962	Processing production 1963
	- - - -Acres- - -		- - - Tons- - - -	
Arnaudville	725	775	2,175	1,975
Breaux Bridge	300	300	550	500
Carencro	195	240	615	465
Church Point	0	10	0	0
Delcambre	150	110	530	230
Lafayette	450	450	1,755	1,215
Leonville	50	350	0	250
New Iberia	400	370	1,000	900
Opelousas	0	25	0	25
Osson	495	300	450	345
Scott	60	90	105	195
St. Martinville	750	675	1,750	2,075
Sunset	575	625	1,600	185
Total	4,150	4,320	10,530	8,360

a/ Since approximately 3 percent of the area's okra production is produced for the fresh market, it is arbitrarily assumed that total okra production is equal to processing production. Acreage and production were not reported in the producing origins not shown in the table.

Estimated tomato production densities were as follows: Bunkie 200 tons, Point Blue 100 tons, Church Point 50 tons, Cottonport 150 tons, Lawtell 50 tons, Opelousas 50 tons, Sunset 100 tons, and Ville Platte 350 tons.

Commodity Supply Schedules, Functions and Elasticity Coefficients

Supply schedules, functions and elasticity coefficients were obtained for each commodity by using the expectational supply model technique described in Chapter II.

The expectational supply schedules for sweet potatoes and okra, by parishes, are shown in Tables 10 and 11, respectively. These schedules show the average yields, prices, total acreage and total production of sweet potatoes and okra for the various parishes and for the South Central Louisiana area.

Tables 12 and 13 present the responsiveness of production to price changes for sweet potatoes and okra for processing. The data have been developed for the 25 producing origins. The expectational supply of sweet potatoes available for processing in South Central Louisiana varies from 21,737 tons if prices are decreased 30 percent from 1963 levels, to 98,599 tons if prices are increased 30 percent. Okra production would disappear if okra prices were decreased 30 percent. Assuming no change in price from the 1963 level, the sweet potato and okra production would be 59,647 and 7,524 tons, respectively.

The supply functions and elasticity coefficients are presented in Tables 14 and 15. Simple regression equations were fitted to the various supply schedules by using the least squares technique. Price was used as the dependent variable and production as the independent variable. Eight sweet potato supply equations and five okra supply equations were fitted in this analysis. All equations yielded

Table 10. Sweet Potatoes: Prices, Total Acreage and Total Production for Supply Estimation, South Central Louisiana, 1963[a] (Original Vegetable Survey Sample Data)

Parish	Average yield	Price decreases			Average price	Price increases		
		30%	20%	10%		10%	20%	30%
	(Crates per acre)							
Acadia	119.90							
Prices ($/crate)		.70	.80	.90	1.00	1.10	1.20	1.30
Total acreage		107	160	166	151	252	259	278
Total production (crates)		12,829	19,184	19,903	18,014	29,015	31,054	33,332
Allen	206.60							
Prices ($/crate)		1.66	1.89	2.12	2.35	2.58	2.81	3.04
Total acreage		12	12	12	12	16	20	24
Total production (crates)		2,479	2,479	2,479	2,479	3,305	4,132	4,958
Avoyelles	171.60							
Prices ($/crate)		1.05	1.19	1.33	1.47	1.61	1.75	1.89
Total acreage		333	494	641	696	933	1,094	1,207
Total production (crates)		57,142	84,770	109,995	119,433	160,102	187,730	207,121
Evangeline	132.90							
Prices ($/crate		.65	.74	.83	.92	1.01	1.10	1.19
Total acreage		171	277	383	493	608	718	799
Total production (crates)		22,725	36,813	50,900	65,519	80,803	95,422	106,187
Lafayette	162.60							
Prices ($/crate)		---	.80	.90	1.00	1.10	1.20	---
Total acreage		---	38	53	99	156	180	---
Total production (crates)		---	6,178	8,617	16,097	25,365	29,268	---

(Continued)

Table 10. (Continued)

Parish	Average yield	Price decreases 30%	20%	10%	Average price	Price increases 10%	20%	30%
	(Crates per acre)							
St. Landry	114.40							
Prices ($/crate		.78	.89	1.00	1.11	1.22	1.33	---
Total acreage		246	320	407	451	558	592	---
Total production (crates)		28,142	36,608	46,560	51,594	63,835	67,724	---
St. Martin	127.60							
Prices ($/crate)		---	.89	.99	1.09	1.19	1.29	---
Total acreage		---	25	44	103	155	192	---
Total production (crates)		---	3,190	5,614	13,142	19,778	24,499	---
South Central Louisiana	136.20							
Prices ($/crate)		.81	.92	1.03	1.14	1.25	1.39	---
Total acreage		873	1,326	1,710	2,003	2,668	3,055	---
Total production (crates)		118,902	180,601	232,902	272,808	363,381	416,091	---

a/ After most interviews were conducted, the Budget Bureau, Washington, D.C., requested that the remaining interviews obtain the reaction of farmers at the 30 percent level of increase and decrease in prices. Hence, in some cases, schedules were obtained from a range of five or seven price quantity relations. In all cases, the analysis was made from the available figures.

Table 11. Okra: Price, Total Acreage and Total Production for Supply Estimation, South Central Louisiana, 1963[a] (Original Vegetable Survey Sample Data)

Parish	Average yield	Price decreases 30%	Price decreases 20%	Price decreases 10%	Average price	Price increases 10%	Price increases 20%	Price increases 30%
	(Tons per acre)							
Iberia	3.00							
Prices ($/ton)		---	39.8	44.7	49.6	54.5	59.4	---
Total acreage		---	11	17	48	58	65	---
Total production (tons)			33	51	144	174	195	---
Lafayette	3.71							
Prices ($/ton)		37.8	43.2	48.6	54.1	59.5	64.9	70.3
Total acreage		19	31	47	68	107	158	74
Total production (tons)		70.4	115.0	174.3	252.2	396.9	586.1	274.5
St. Landry	3.44							
Prices ($/ton)		47.2	53.9	60.7	67.4	74.2	80.9	---
Total acreage		3	14	26	39	55	62	---
Total production (tons)		10.3	48.1	89.4	134.1	189.2	213.2	---
St. Martin	3.58							
Prices ($/ton)		---	34.0	38.2	42.5	46.7	51.0	55.2
Total acreage		---	14	28	49	90	109	2
Total production (tons)		---	50.1	100.2	175.4	322.2	390.2	2.2
South Central Louisiana	3.50							
Prices ($/ton)		36.6	41.8	47.0	52.3	57.5	62.7	---
Total acreage		22	70	118	204	310	394	---
Total production (tons)		77.0	245.0	413.0	714.0	1,085.0	1,379.0	---

a/ After most interviews were conducted, the Budget Bureau, Washington, D. C., requested that the remaining interviews obtain the reaction of farmers at the 30 percent level of increase and decrease in prices. Hence, in some cases, schedules were obtained from a range of five or seven price quantity relations. In all cases, the analysis was made from the available figures.

Table 12. Sweet Potatoes Available for Processing: Responsiveness of Price Increases and Decreases Upon Production, by Producing Origins, South Central Louisiana[a]

Production origin	Production assuming price decrease 30 Percent	20 Percent	10 Percent	Production assuming no change from 1963 price level	Production assuming price increase 10 Percent	20 Percent	30 Percent
				-Tons-			
Arnaudville	0	663	1,686	2,709	3,732	4,754	5,776
Branch	1,408	1,859	2,309	2,760	3,210	3,660	4,111
Breaux Bridge	0	85	217	350	482	614	746
Carencro	0	331	854	1,375	1,897	2,419	2,941
Point Blue	1,086	1,798	2,511	3,224	3,987	4,650	5,362
Church Point	2,318	3,059	3,800	4,542	5,284	6,026	6,767
Cottonport	2,443	3,704	4,964	6,225	7,485	8,746	10,006
Hessmer	2,307	3,497	4,688	5,878	7,067	8,258	9,449
Lafayette	0	590	1,522	2,454	3,385	4,317	5,248
Lawtell	1,055	1,378	1,705	2,030	2,355	2,680	3,005
Leonville	678	887	1,096	1,305	1,513	1,722	1,932
Mansura	618	938	1,256	1,576	1,891	2,210	2,528
Oberlin	564	750	938	1,125	1,313	1,499	1,686
Opelousas	1,538	2,012	2,486	2,960	3,433	3,908	4,381
Osson	0	192	493	796	1,096	1,398	1,700
St. Martinville	0	18	46	75	103	131	160
Sunset	2,545	3,330	4,114	4,898	5,682	6,466	7,250
Ville Platte	5,177	8,573	11,968	15,364	18,759	22,154	25,551
Total	21,737	33,664	46,653	59,646	72,624	85,612	98,599

a/ Since data for certain parishes was not obtained at the 30 percent price increase and decrease levels, estimates were computed on the basis of available data for lower levels of price changes. Responsiveness was not estimated for the producing origins not shown in the table. No production was reported at those points.

Table 13. Okra Available for Processing: Responsiveness of Price Increases and Price Decreases Upon Production, by Producing Origins, South Central Louisiana[a]

Production origin	Production assuming price decrease 30 Percent	Production assuming price decrease 20 Percent	Production assuming price decrease 10 Percent	Production assuming no change from 1963 price level	Production assuming price increase 10 Percent	Production assuming price increase 20 Percent	Production assuming price increase 30 Percent
	Tons						
Arnaudville	0	186	982	1,778	2,574	3,369	4,165
Breaux Bridge	0	47	248	450	651	852	1,054
Carencro	0	96	257	418	578	739	900
Delcambre	0	38	122	207	291	375	460
Lafayette	0	251	672	1,094	1,515	1,936	2,357
Leonville	0	65	145	225	304	384	464
New Iberia	0	150	480	810	1,139	1,469	1,798
Opelousas	0	6	14	22	29	38	45
Osson	0	58	184	310	429	562	688
Scott	0	50	108	176	244	311	379
St. Martinville	0	196	1,032	1,868	2,704	3,540	4,376
Sunset	0	48	107	166	225	284	342
Total	0	1,191	4,351	7,526	10,713	13,859	17,028

a/ Fresh market supplies and unmarketable okra for processing have been deleted from the tabular figures. Since data for certain parishes were not obtained at the 30 percent price increase and decrease levels, estimates were computed on the basis of available data for lower levels of price changes. Responsiveness was not estimated for the producing origins not shown in the table. No production was reported at those points.

Table 14. Estimated Values of Regression Coefficients and Elasticity Coefficients for Supply Equations, Sweet Potatoes, South Central Louisiana, 1963

Parish	Supply equation $P = a + bQ$	F value	Supply elasticity coefficient N_s
Acadia	$P = .387 + 0.0000262Q$	38.32**	1.632
Allen	$P = .947 + 0.000439Q$	17.84**	1.663
Avoyelles	$P = .744 + 0.00000548Q$	413.69**	2.025
Evangeline	$P = .505 + 0.00000633Q$	3,782.00**	2.210
Lafayette	$P = .736 + 0.0000154Q$	94.03**	3.796
St. Landry	$P = .399 + 0.0000133Q$	316.47**	1.601
St. Martin	$P = .861 + 0.0000172Q$	154.50**	3.775
South Central Louisiana	$P = .585 + 0.00000191Q$	411.60**	2.158

** Significant at the .01 level.

Table 15. Estimated Values of Regression Coefficients and Elasticity Coefficients for Supply Equations, Okra, South Central Louisiana, 1963

Parish	Supply equation $P = a + bQ$	F value	Supply elasticity coefficient N_s
Iberia	$P = 37.41 + 0.1021Q$	40.94**	4.068
Lafayette	$P = 38.01 + 0.050Q$	49.71**	3.849
St. Landry	$P = 46.03 + 0.158Q$	639.33**	3.552
St. Martin	$P = 32.99 + 0.045Q$	98.69**	4.475
South Central Louisiana	$P = 37.16 + 0.019Q$	170.28**	3.807

** Significant at the .01 level.

statistically significant results at the .01 level of probability. From the sweet potato supply equation for South Central Louisiana, it can be illustrated that no production would be forthcoming if the price was $0.58 per crate.

Generally, the supply functions for sweet potatoes and okra were found to be elastic. This indicates that producers of these commodities will react strongly to price changes. The supply elasticities for sweet potatoes ranged from 1.632 in Acadia Parish to 3.796 in Lafayette Parish. Okra supply elasticities ranged from 3.552 in St. Landry Parish to 4.475 in St. Martin Parish.

Statistical Tests for Supply Functions by Parishes

Simple linear supply functions can be tested statistically to determine if one regression of the usual form can be fitted to all observations and if the same regression coefficient can be used for the independent variable considered. The computational procedure for these statistical tests was outlined in Chapter II.

Seven sweet potato supply functions and four okra supply functions were selected for the analysis. It was of particular importance to determine if any difference existed among the linear supply functions by parishes since the area has been labeled as a unique region due to the existence of traditional agricultural products.

The tests for the sweet potato producing parishes revealed that calculation of F = 91.9617 with 12 degrees of freedom and F = 19.8211 with six degrees of freedom indicated that one regression of the usual form cannot be fitted to all observations and that the same regression coefficients cannot be used for the independent variable considered (see Table 16). Thus a difference was found in the supply behavior of individual sweet potato producing parishes.

The tests for the okra producing parishes also revealed that one regression of the usual form cannot be fitted to all observations and that the same regression coefficients cannot be used for the independent variable considered. Calculation of F = 89.4223 with six degrees of freedom and F = 26.8804 with three degrees of freedom is shown in Table 17. Thus, a significant difference was found in the supply behavior of individual okra producing parishes.

Table 16. Calculation of Mean Squares for Testing Hypotheses Regarding Regression in Groups, Sweet Potato Supply Functions

Source of variation	d.f.	Sum of squares	Mean squares	F value
Total	42	13.5292	---	---
Within	36	1.7769	---	---
$\Sigma\Sigma d^2$	30	.3574	.0119	---
Test 1	12	13.1718	1.0976	91.9617**
Test 2	6	1.4195	.2365	19.8211**

** Significant beyond the .01 level.

Table 17. Calculation of Mean Squares for Testing Hypotheses Regarding Regression in Groups, Okra Supply Functions

Source of variation	d.f.	Sum of squares	Mean squares	F value
Total	20	2557.4190	---	---
Within	17	439.6418	---	---
$\Sigma\Sigma d^2$	14	65.0347	4.6453	---
Test 1	6	2492.3842	415.3973	89.4223**
Test 2	3	374.6070	124.8690	26.8804**

** Significant beyond the .01 level.

The results of the tests for sweet potatoes and okra supply functions indicated that one regression of the usual form could not be fitted for all parishes and that the same regression coefficient for the independent variable could not be used. Therefore, it is obvious that the price intercepts and the regression coefficients for individual parishes are different.

Statistical Tests for Supply Functions of Selected Groups of Sweet Potato Producers

Thirteen groups of sweet potato producers were selected for further study of supply behavior. The supply schedules and estimated values of regression coefficients are presented in Tables 18 and 19, respectively. The purpose of the analysis was to study the supply functions as a group and by corresponding pairs. The group tests were made in order to determine if one regression of the usual form can be

Table 18. Prices and Production for Supply Elasticity Estimation: Selected Groups of Sweet Potato Producers, South Central Louisiana[a/], 1963

Selected groups	Price decreases 30%	20%	10%	Average price	Price increases 10%	20%	30%
White farmers							
Price (dollars/crate)	.87	.99	1.11	1.24	1.36	1.48	1.61
Production (crates)	72,322	113,182	141,648	160,307	224,146	250,471	262,321
Negro farmers							
Price (dollars/crate	.75	.85	.95	1.05	1.15	1.25	---
Production (crates)	41,813	62,379	84,852	107,734	133,203	156,766	---
Contractees							
Price (dollars/crate)	---	.69	.78	.88	.98	1.16	1.26
Production (crates)	---	12,258	21,655	30,508	42,630	59,928	68,100
Non-Contractees							
Price (dollars/crate)	.86	.98	1.11	1.23	1.35	1.47	1.60
Production (crates)	80,630	114,135	138,651	151,863	210,837	242,163	250,471
Part contractors							
Price (dollars/crate)	.73	.83	93	1.04	1.14	1.24	---
Production (crates)	26,014	44,537	62,107	78,587	90,164	103,103	---
Above average education producers							
Price (dollars/crate)	.87	.99	1.11	1.24	1.36	1.48	---
Production (crates)	60,472	94,386	127,210	152,271	201,576	230,722	---
Below average education producers							
Price (dollars/crate	.75	.85	.95	1.05	1.15	1.25	---
Production (crates)	58,428	85,942	104,056	120,809	163,167	182,644	---

(Continued)

Table 18. (Continued)

Selected groups	Price decreases 30%	20%	10%	Average price	Price increases 10%	20%	30%
Above average sweet potato acreage producers							
Price (dollars/crate)	.80	.91	1.03	1.14	1.25	1.37	1.48
Production (crates)	75,727	118,085	156,221	185,913	236,170	266,952	286,701
Below average sweet potato acreage producers							
Price (dollars/crate)	.80	.90	1.02	1.13	1.24	1.35	---
Production (crates)	43,175	62,243	75,046	87,168	124,759	146,415	---
Above average experience producers							
Price (dollars/crate)	.69	.78	.98	1.16	1.26	1.37	---
Production (crates)	59,655	80,766	99,970	121,354	149,139	158,945	---
Below average experience products							
Price (dollars/crate)	.78	.89	1.00	1.11	1.22	1.33	---
Production (crates)	59,247	99,622	131,296	151,726	211,791	254,421	---
Land owners							
Price (dollars/crate)	.91	1.03	1.14	1.25	1.37	1.48	1.60
Production (crates)	64,967	92,343	122,988	152,271	199,260	227,998	239,439
Share-croppers							
Price (dollars/crate)	.73	.83	.93	1.04	1.14	1.24	---
Production (crates)	48,214	68,917	87,168	105,691	134,020	153,906	---

a/ After most interviews were conducted, the Budget Bureau, Washington, D. C., requested that the remaining interviews obtain the reaction of farmers at the 30 percent level of increase and decrease in prices. Hence, in some cases, schedules were obtained from a range of five or seven price quantity relations. In all cases, the analysis was made from the available figures.

Table 19. Estimated Values of Regression Coefficients and Supply Elasticities for Selected Groups of Sweet Potato Producers, South Central Louisiana, 1963

Selected groups	Supply equation P = a + bQ	F value	Supply elasticity coefficient	Average price received	Number of producers
				(Dollars per crate)	
White farmers	P = .602 + .00000363Q	189.66**	1.940	1.23	76
Negro farmers	P = .577 + .00000431Q	3,650.20**	2.351	.99	116
Contractees	P = .564 + .000000100Q	2,276.09**	2.429	.95	50
Non-contractees	P = .551 + .00000398Q	161.30**	1.407	1.22	93
Part-contractors	P = .539 + .00000660Q	486.91**	2.207	.98	53
Above average education producers	P = .661 + .00000355Q	574.37**	2.285	1.17	84
Below average education producers	P = .528 + .00000395Q	228.76**	2.100	.99	112
Above average sweet potato acreage producers	P = .549 + .00000311Q	560.71**	1.910	1.13	60
Below average sweet potato acreage producers	P = .603 + .00000522Q	105.06**	2.280	1.07	136
Above average experience producers	P = .269 + .00000689Q	204.11**	1.330	1.03	91
Below average experience producers	P = .625 + .00000283Q	220.15**	2.450	1.05	105
Land owners	P = .685 + .00000362Q	355.94**	2.200	1.25	74
Share-croppers	P = .505 + .00000481Q	771.73**	2.045	.98	112

** Significant beyond the .01 level.

fitted to all observations and if the same regression coefficient can be used for the independent variable considered. The tests for the corresponding pairs were made to test the hypothesis that the regression coefficients are estimates of the same population regression coefficient.

The results of the statistical tests for all groups are shown in Table 20. The calculated values of F = 42.28 with 24 degrees of freedom and F = 25.34 with 12 degrees of freedom indicated that one regression of the usual form cannot be fitted to all observations and that the same regression coefficients cannot be used for the independent variable considered. Therefore, a difference was found in the supply behavior of the selected group of sweet potato producers. Thus, the respective price intercepts and regression coefficients for the various selected groups are different.

The results for the tests of hypothesis that two regression coefficients are estimates of the same population regression coefficient are presented in Table 21. Race and education were the factors found not significant in the analysis. Existence of contracts, average vegetable acreage, years of experience in vegetable production and land tenure characteristics were found to be significantly different when considered as separate regression lines.

The supply elasticity of contractees (2.429) and part-contractors (2.207) was found to be significantly greater than that of non-contractees (1.407). The analysis also revealed that producers having above average sweet potato acreage were less responsive to price

Table 20. Calculation of Mean Squares for Testing Hypotheses Regarding Regression in Groups, Selected Groups of Sweet Potato Supply Functions, South Central Louisiana, 1963

Source of variation	d.f.	Sum of squares	Mean squares	F value
Total	80	.9563	---	---
Within	68	.3275	---	---
$\Sigma \Sigma d^2$	66	.0584	.000884	---
Test 1	24	.8979	.037412	42.28**
Test 2	12	.2691	.022425	25.34**

** Significant beyond the .01 level.

Table 21. Calculation of t Values for Testing Hypotheses that Two Regression Coefficients are Estimates of the Same Population Regression Coefficient, Selected Groups of Sweet Potato Supply Functions, South Central Louisiana, 1963

Selected groups compared	Degrees of freedom	t value
White vs. Negro farmers	9	1.6571NS
Contractees vs. non-contractees	9	80.8322**
Part-contractees vs. non-contractees	9	3.9558**
Above vs. below average education producers	8	1.3711NS
Above vs. below average vegetable acreage producers	9	4.7629**
Above vs. below average years experience producers	8	8.4406**
Land owners vs. share-croppers	9	3.6020**

** Significant beyond the .01 level.

NS Not significant.

changes than below average sweet potato acreage producers (supply elasticities were 1.910 and 2.280, respectively). Significant differences were also obtained for the supply elasticities of above average experience producers (1.330) and below average experience producers (2.450). Land owners and share-croppers were found to have significantly different supply elasticity coefficients (2.200 and 2.045, respectively). The characteristics studied appear reasonably related to the behavior of producers and the nature of the study area.

CHAPTER IV

OPTIMUM NUMBER, SIZE, AND LOCATION OF MULTIPLE PRODUCT VEGETABLE PROCESSING PLANTS

Because of the seasonal nature of agricultural production, processing establishments often extend the length of their season and/or increase plant output by handling two or more commodities. When fresh and perishable commodities are unavailable, processors may also process non-seasonal items in order to lengthen the processing season and/or augment overall volume.

While Stollsteimer's "Working Model for Plant Numbers and Locations," provides an excellent operational tool for determining the number, size, and location of plants that minimize combined transportation and processing costs, it does so for only one raw material or product.[1] The generalized version of the model to permit multiple product processing was presented in Chapter II. The purpose of the following analysis is to apply the generalized model to South Central Louisiana as a case involving three raw and final products (sweet potatoes, okra, and tomatoes), 25 producing origins, and 10 potential processing locations. It is assumed that okra and tomatoes are processed simultaneously because of the coincident harvesting season in the area, while sweet potatoes are processed in a subsequent period.

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[1]John F. Stollsteimer, "A Working Model of Plant Numbers and Locations," Journal of Farm Economics, Vol. 45, August 1963, p. 632.

The effects of price changes on production and on processing locations will be studied according to the supply elasticity relationships found with the expectational supply model. For the purpose of this analysis, the effect of price increases and decreases on quantities supplied will be studied.

Thus, the problem is one of determining the number, size, and location of facilities that will minimize the combined cost of assembling and processing the raw products studied in the region.

The Cost of Raw Product Assembly

Description of Assembly Operations

Louisiana sweet potato and okra producers commonly use trucks to assemble the raw product. Size of the truck used depends on such factors as volume of production (bushels per season), rate of output (bushels per hour) and distance from field to plant. All of these factors have been considered in deriving an assembly cost function suitable for estimating the cost of assembling the raw product.

Labor requirements for loading a truck vary with size of truck and type of loading facilities. The total amount of labor which is required to assemble sweet potatoes and okra depends on size of truck, rate of output (bushels per hour) and distance between field and plant. All of these variables are important in determining assembly costs. However, the total costs associated with varying distances traveled is of primary concern in this study.

Method of Estimating Assembly Costs

The costs associated with the assembly operations can be separated into two types. The first type is composed of fixed loading and unloading costs per ton of raw product. In general, these costs do not vary with use or miles traveled. The second type of expense refers to variable costs per mile. These costs include total fixed cost per mile, total variable cost per mile, and road hauling costs per mile.

Estimation of costs for trucks transporting raw materials is complicated by the fact that very few trucks are used solely for hauling only one product. Sweet potato harvesting and marketing operations usually begin in September and end in December. Okra harvesting and marketing operations usually begin in June and end in August. For this reason, standard seasons of nine and one-half weeks and sixteen weeks were assumed for okra and sweet potatoes, respectively. Cost data are based on 28 trips per season for okra and 48 trips per season for sweet potatoes.

Three sizes of trucks were selected for computing assembly costs. The small size truck was a 1/2-3/4 ton capacity truck hauling on the average one ton of raw product.[2] The medium size truck was a 1-1½ ton capacity truck hauling on the average two tons of raw product.

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[2]Capacities indicated are those of the manufacturers. However, owners modified their trucks to allow greater capacities than specified.

The large size truck was a two-ton capacity truck averaging seven tons of raw product per haul. The average mileage per round haul was as follows: small trucks 25 miles per haul, medium trucks 30 miles per haul, and large trucks 50 miles per haul. Data used to estimate truck and labor costs were provided by truck operators and authorized dealers. The economic-engineering approach was used to synthesize these data. This approach is a process of deriving input-output coefficients based on expected requirements and performances which are used to compute costs and returns from productive activities.

The Cost-Distance Relationship

The cost-distance relationship can be expressed in terms of highway miles. The assembly cost function in terms of highway miles would appear to be meaningful to raw product processors and producers. The cost-distance relationship in terms of road miles for the various trucks studied is stated in the following equation:

(1) $TC = a + b \cdot M$

where TC = total assembly cost in dollars per ton

a = fixed costs per ton of raw product (there are loading and unloading costs per ton of raw product)

b = variable costs per mile

M = distance in road miles

The assembly cost function is calculated on the basis of road miles. For the purpose of the plant location analysis, a mileage chart from each producing origin to every destination must be computed in order to estimate total assembly costs.

The Assembly Cost Estimates

The estimated fixed and variable costs of assembling sweet potatoes and okra for various trucks are presented in Table 22. Unit assembly costs represent fixed and variable raw product transportation costs, as well as loading and unloading cost. The linear equations were fitted for three basic truck sizes. The assembly cost data fitted into cost equations demonstrated economies of large-sized truck operations. As an illustration, sweet potato variable cost is $0.142 for small trucks but for large size trucks the cost decreases considerably to $0.033. If loading and unloading costs are considered, small truck cost is $3.750 and large truck cost is $2.385.

The following example illustrates the procedure employed to compute total assembly costs. The cost-distance equation for small trucks hauling sweet potatoes is $TC = 3.750 + 0.142 M$. If one ton of raw product is transported from Breaux Bridge to Opelousas (34 miles) the total cost of assembly is $8.57. The same procedure is utilized to compute the unit cost of assembling raw products from production origins to processing locations. The computed unit costs provide the necessary assembly cost coefficients for the transfer cost matrix of the plant location model.

Table 22. Estimated Fixed and Variable Costs of Assembling Sweet Potatoes and Okra, South Central Louisiana, 1963

Truck size	Raw material	TFC per mile	TVC per mile	Road hauling costs per mile	Loading and unloading costs per ton	Variable cost per mile
		------------Dollars------------			Dollars (a)	Dollars (b)
Small (1/2-3/4 Ton)	Sweet potatoes	0.034	0.053	0.055	3.750	0.142
Medium (1-½ Ton)	Sweet potatoes	0.020	0.030	0.315	3.180	0.082
	Okra	0.020	0.030	0.315	3.499	0.082
Large (2-3 Ton)	Sweet potatoes	0.065	0.127	0.142	2.385	0.033
	Okra	0.065	0.127	0.142	2.623	0.033

The Cost of Raw Product Processing

The minimum costs to establish and maintain a plant are an important determinant in location analysis. Generalized economic-engineering methods for estimating costs of processing raw product have been utilized to derive cost equations.[3] Processing costs are minimized for each level of output by deriving an estimating equation based on the optimum rates of output and lengths of season.

The linear processing cost equations for the three raw products are as follows:

(1) Canned Sweet Potatoes:

$$TPC_{sp} = 104,840 + 2.97Q_{sp}$$

(2) Canned Okra:

$$TPC_{o} = 68,078 + 2.38Q_{o}$$

(3) Canned Tomatoes:

$$TPC_{t} = 40,895 + 2.86Q_{t}$$

Equations (1), (2), and (3) define TPC as total processing cost in dollars and Q refers to cases (no. 303) of processed output. The constant is a mixed term including the minimum costs of establishing a plant. The signs and relative magnitudes of the coefficients of equations (1), (2), and (3) appear reasonable.

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[3]The basic processing cost data used in this study were drawn from: Leo Polopolus and Clayton Strebeck, Feasibility of Additional Vegetable Processing Plants in South Central Louisiana (D.A.E. Research Report No. 341; Baton Rouge: Louisiana Agricultural Experiment Station, April 1965), pp. 27-55.

Processing costs, as related to the minimization problem, are defined as the sum of the intercept values, \$213,813, minus joint processing costs. Joint processing costs involving the processing of sweet potatoes, okra, and tomatoes are \$43,618. (Okra and tomato canning is sequentially linked to sweet potato canning). Assuming that the three raw products are processed at one location, the intercept value of the multiple product processing equation becomes \$170,195. Joint processing cost for canning okra and sweet potatoes is \$38,000, while joint processing cost for canned sweet potatoes and canned tomatoes is \$27,700. The intercept value for canning okra and sweet potatoes becomes \$134,918, while the intercept value for canning sweet potatoes and tomatoes is \$118,035. No joint costs are assumed for the canned okra-tomato combination since they are processed simultaneously.

The Optimum Locational Patterns and Optimum Allocation of Raw Products

The three variables of production density, assembly costs, and processing costs have been integrated in sequence to determine the optimum location that minimizes the cost of raw product assembly and processing.

The scope of this investigation is focused upon study of the following two cases: (I) optimum location patterns and optimum allocations of raw products for the seven "old" processing locations in South Central Louisiana for the given supply levels of raw product, and (II) optimum locational patterns and optimum allocations of raw products for ten processing locations with long-run projections for potential processing localities in South Central Louisiana. Minimization of assembly and processing costs with respect to plant numbers was accomplished with the aid of a computer program written at Louisiana State University for the IBM 7040. The unit costs of assembling raw products from production locations to processing locations are shown in Appendix Tables 1, 2, and 3 (Case I) and 4, 5, and 6 (Case II).

Case I

The minimum assembly and processing costs, optimum processing locations, and optimum allocations of raw products available for processing, at the various price levels and production densities for seven old processing locations in South Central Louisiana are presented in Table 23 and in Appendix Tables 7 through 12.

The results indicate that if one multiproduct plant was considered to process all of the available supply, Opelousas would represent the "optimum" processing location in terms of minimizing assembly and processing costs. At the current 1963 price level, it was estimated that the minimum total cost of establishing a plant at Opelousas would be $369,833 (Table 23). If seven locations were considered, the minimum total cost would be $1,073,692. If overall minimum total costs are considered, one plant would be preferable for minimizing total cost (Table 24).

Table 23. Case I: Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocations of Raw Products Available for Processing, at Current 1963 Price Levels, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		- - - - - - Dollars-	- - - - -		- - - - - - - - -Tons-	- - - - - -	
1	Opelousas	199,638	170,195	369,833	59,646	7,526	1,050
2	Lafayette	192,729	305,113	497,842	5,050	5,333	
	Opelousas				54,596	2,193	1,050
3	Lafayette	188,585	423,148	611,733	5,050	5,333	
	Opelousas				36,568	2,193	
	Ville Platte				18,028		800
4	Church Point	185,203	541,183	726,386	7,302		50
	Lafayette				5,050	5,333	
	Opelousas				29,266	2,193	150
	Ville Platte				18,028		850
5	Church Point	184,262	711,378	895,640	7,302		50
	Lafayette				4,975	2,448	
	New Iberia				75	2,885	200
	Opelousas				29,266	2,193	200
	Ville Platte				18,028		600

(Continued)

Table 23. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products Sweet potatoes	Okra	Tomatoes
		- - - - - - Dollars-	- - - - -		- - - - - - - - Tons-	- - - - - -	
6	Breaux Bridge	183,732	846,296	1,030,028	3,059	2,228	
	Church Point				7,302		50
	Lafayette				4,625	1,998	
	New Iberia				75	2,075	200
	Opelousas				26,557	1,225	200
	Ville Platte				18,028		600
7	Breaux Bridge	183,645	890,047	1,073,692	3,059	2,228	
	Church Point				7,302		50
	Lafayette				4,625	1,998	
	New Iberia					2,075	200
	Opelousas				26,557	1,225	200
	St. Martinville				75		
	Ville Platte				18,028		600

Table 24. Summary of Combined Minimum Total Assembly Cost and Minimum Processing Cost for Raw Products Available for Processing at 1963 Price Levels, Case I, South Central Louisiana

Number of plants	Minimum total assembly cost	Minimum processing cost	Minimum total cost
	- - - - - - - - -	-1,000 dollars -	- - - - - - - -
1	199,638	170,195	369,833
2	192,729	305,113	497,842
3	188,585	423,148	611,733
4	185,203	541,183	726,386
5	184,262	711,378	895,640
6	183,732	846,296	1,030,028
7	183,645	890,047	1,073,692

The relationship of total processing cost and total assembly cost to plant numbers is shown in Figure 4. As plant numbers increase, minimum total assembly cost decreases while minimum total processing cost and minimum total cost increases (Table 24). As indicated by Figure 4, processing cost increases at a greater rate than assembly cost decreases. Thus, when considered as a function of plant numbers, minimum total processing cost rises with increases in plant numbers and minimum total assembly cost decreases with increases in plant numbers.

Case I represents the optimum processing location (Opelousas) and raw product allocation of the existing South Central Louisiana industry. It represents the optimum pattern of raw product

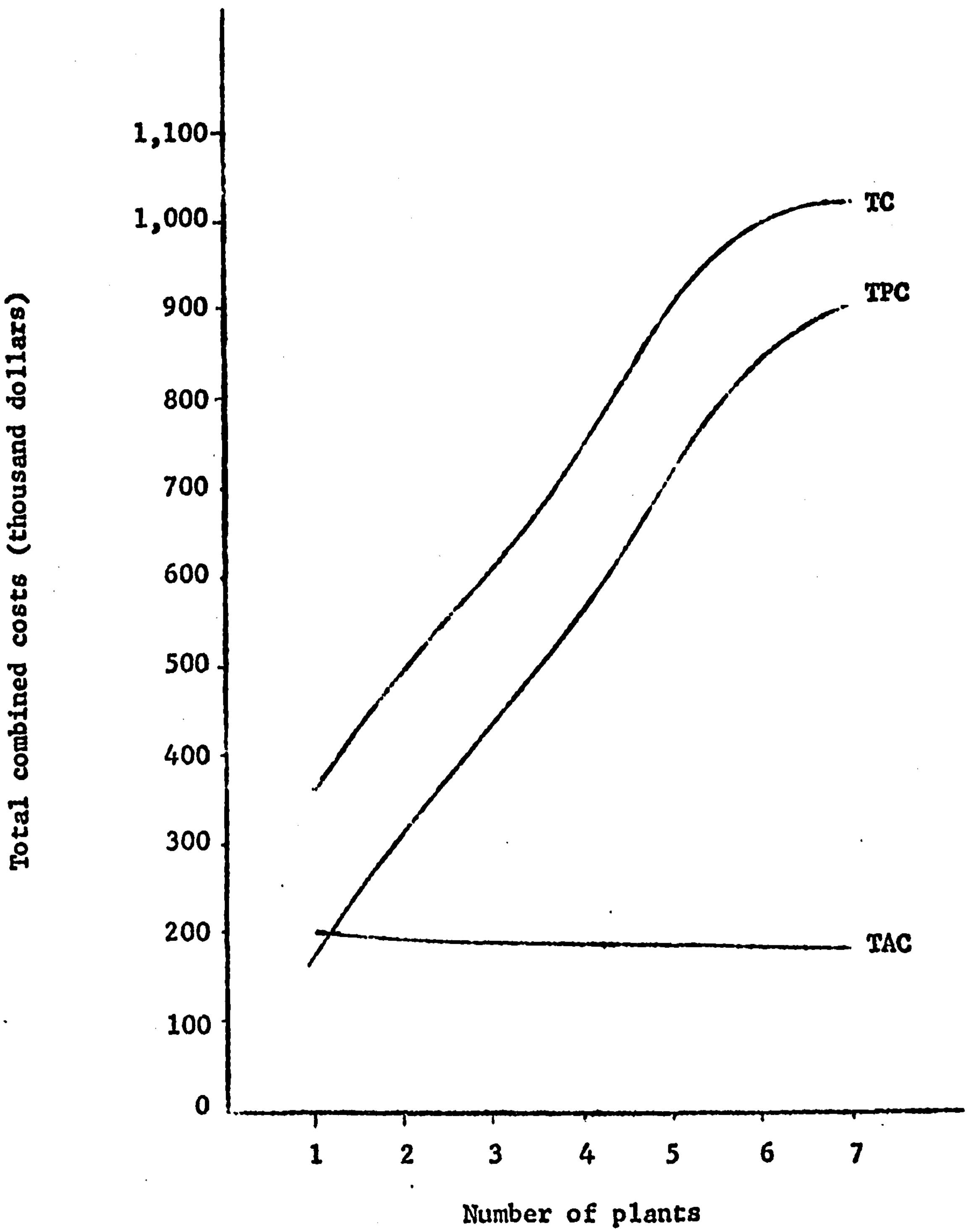

Figure 4. Case I. The Relationship of Total Processing Costs and Total Assembly Costs to Plant Numbers.

allocation of processing supplies. Thus, the optimum plant located at Opelousas would process 59,646 tons of sweet potatoes, 7,525 tons of okra, and 1,050 tons of tomatoes.

The "sub-optimum" solution of the foregoing analysis is one that involves the operation of seven plants (Table 23). It indicates that all locations but New Iberia should process sweet potatoes. However, New Iberia represents a feasible location for processing large quantities of okra (2,075 tons) and tomatoes (200 tons). The Opelousas location is the only location to process all three products. The consideration of seven existing processing locations in the overall processing location analysis gives the proper allocation of raw products for each processing location, and the respective costs of assembling and processing the raw materials.

The study of Case I reveals the optimum location to be Opelousas. It also affords a way to compare the efficiency of the existing industry by allocating the raw materials to be processed at each location. It also points out that if the industry should relocate or increase capacity, the most feasible location to consider is Opelousas.

Case II

While Case I represented an investigation of actual processing locations, it is intended that Case II study the possibility of determining future location sites. The selection of new plant sites was somewhat arbitrary. The overall locations constitute five actual processing locations plus five new locations. The overall technique presupposes that new plants should locate near the high production density area in the northern section of the area. The actual locations selected were Breaux Bridge, Church Point, Lafayette, Opelousas, and Ville Platte. Breaux Bridge was selected due to its proximity to the okra producing region. Lafayette was selected due to its history as a vegetable processing center. Church Point, Opelousas, and Ville Platte were selected due to their overall central locality within the producing region.

The new locations included in the study were Bunkie, Carencro, Hessmer, Lawtell, and Sunset. The selection of Bunkie and Hessmer was based upon the prominence of Avoyelles Parish as the largest sweet potato producer in South Central Louisiana. Carencro, Lawtell, and Sunset were selected because of their proximity to important producing areas in St. Landry and Evangeline Parishes. Also, they are close to the central okra producing region in Lafayette Parish.

The unit costs of assembling raw products from production to potential processing locations for sweet potatoes, okra, and tomatoes are presented in Appendix Tables 4 through 7. The analysis indicated that Opelousas is the "optimum" plant location for all cases of price fluctuations and that it is the location that minimizes assembly and processing costs (Table 25 and Appendix Tables 13 through 18).

Based upon the assumption that prices will increase 10 percent over a period of seven years, the minimized assembly and processing costs and the optimum raw product allocation are presented in Table 25. The estimated increase in production comes originally from

Table 25. Case II. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocation of Raw Products Available for Processing, Increasing 1963 Prices by 10 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		- - - - - - Dollars	- - - - -		- - - - - - Tons	- - - - - -	
1	Opelousas	249,503	170,195	419,698	72,624	10,713	1,557
2	Hessmer	229,087	288,230	517,317	16,443		519
	Opelousas				56,181	10,713	1,038
3	Hessmer	219,415	423,148	642,563	16,443		519
	Lafayette				6,963	7,551	
	Opelousas				49,218	3,162	1,038
4	Church Point	215,333	541,183	756,516	9,807		74
	Hessmer				16,443		519
	Lafayette				6,963	7,551	
	Opelousas				39,411	3,162	964
5	Church Point	213,348	711,378	924,726	9,807		74
	Hessmer				16,443		519
	Lafayette				6,963	7,551	
	Opelousas				33,729	2,907	816
	Sunset				5,682	255	148
6	Church Point	211,450	829,413	1,040,863	8,494		74
	Hessmer				16,443		519
	Lafayette				6,963	7,551	
	Opelousas				29,792	2,907	148
	Sunset				5,682	255	148
	Ville Platte				5,250		668

(Continued)

Table 25. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		- - - - - - Dollars-	- - - - -		- - - - - - Tons-	- - - - - -	
7	Breaux Bridge	210,617	964,331	1,174,948	4,317	5,929	
	Church Point				8,494		74
	Hessmer				16,443		519
	Lafayette				6,378	4,196	
	Opelousas				26,060	333	148
	Sunset				5,682	255	148
	Ville Platte				5,250		668
8	Breaux Bridge	210,105	1,099,249	1,309,354	4,317	5,929	
	Carencro				1,897	578	
	Church Point				8,494		74
	Hessmer				16,443		519
	Lafayette				4,481	3,618	
	Opelousas				26,060	333	148
	Sunset				5,682	255	148
	Ville Platte				5,250		668
9	Breaux Bridge	209,625	1,217,284	1,426,909	4,317	5,929	
	Carencro				1,897		
	Church Point				8,494		74
	Hessmer				16,443		519
	Lafayette				4,481	3,618	
	Lawtell				2,355		74
	Opelousas				23,705	333	74
	Sunset				5,682	255	148
	Ville Platte				5,250		668

(Continued)

Table 25. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products Sweet potatoes	Okra	Tomatoes
		- - - - - - - Dollars- - - - - -			- - - - - - - Tons- - - - - - -		
10	Breaux Bridge	209,306	1,322,124	1,531,430	4,317	5,929	
	Bunkie				7,485		519
	Carencro				1,897	578	
	Church Point				8,494		74
	Hessmer				8,958		
	Lafayette				4,481	3,618	
	Lawtell				2,355		74
	Opelousas				23,705	333	74
	Sunset				5,682	255	148
	Ville Platte				5,250		668

calculated supply elasticities for the raw products considered. The analysis reveals that if only one plant was considered, Opelousas would represent a three product plant processing 72,624 tons of sweet potatoes, 10,713 tons of okra, and 1,557 tons of tomatoes. Minimum total cost of establishing one plant is estimated to be $419,698.

If two plants are considered for the analysis, Hessmer and Opelousas represent the optimum processing locations. Hessmer would handle 16,443 tons of sweet potatoes and 519 tons of tomatoes. The raw product allocated to Opelousas will be as follows: 56,181 tons of sweet potatoes, 10,713 tons of okra, and 1,038 tons of tomatoes. This phase of the analysis reveals the importance of the northern sections as potential processing locations. However, Opelousas still remains as the major processing center (Table 25). The minimum total cost of establishing plants at Hessmer and Opelousas is $517,317.

The ten plant analysis reveals the importance of the proximity of the supply area to the processing center. For sweet potato processing, Opelousas received 32.64 percent (23,705 tons) of the total estimated production, while Bunkie, Church Point, and Hessmer took approximately 11 percent each (7,485, 8,494, and 8,958 tons, respectively). These processing locations are close to the high sweet potato production density areas. Breaux Bridge (55.34 percent and 5,929 tons) and Lafayette (33.7 percent and 3,618 tons) received the largest amounts of okra production. Tomato production was directed primarily to Ville Platte (42.90 percent and 668 tons) and Bunkie

(33.33 percent and 519 tons). All the potential sites mentioned are located within the high production density areas. The general allocation pattern reveals that there is great potential for future plant locations in the northern section of South Central Louisiana. The minimum total cost of assembling the raw product and establishing the plants was estimated to be $1,531,430.

The relationship between total processing cost and total assembly cost to plant numbers is shown in Figure 5, and Table 26. With an increase in the number of plants, total assembly cost decreases and total processing cost increases. The assembly cost curve declines at a relatively slow rate while the processing cost curve rises at a greater rate. The "optimum" solution indicates that to minimize cost, one plant represents the minimum total cost of establishing and assembling raw products (Opelousas location at a minimum cost of $419,698). In turn, the minimum cost of establishing ten plants is estimated at $1,531,430.

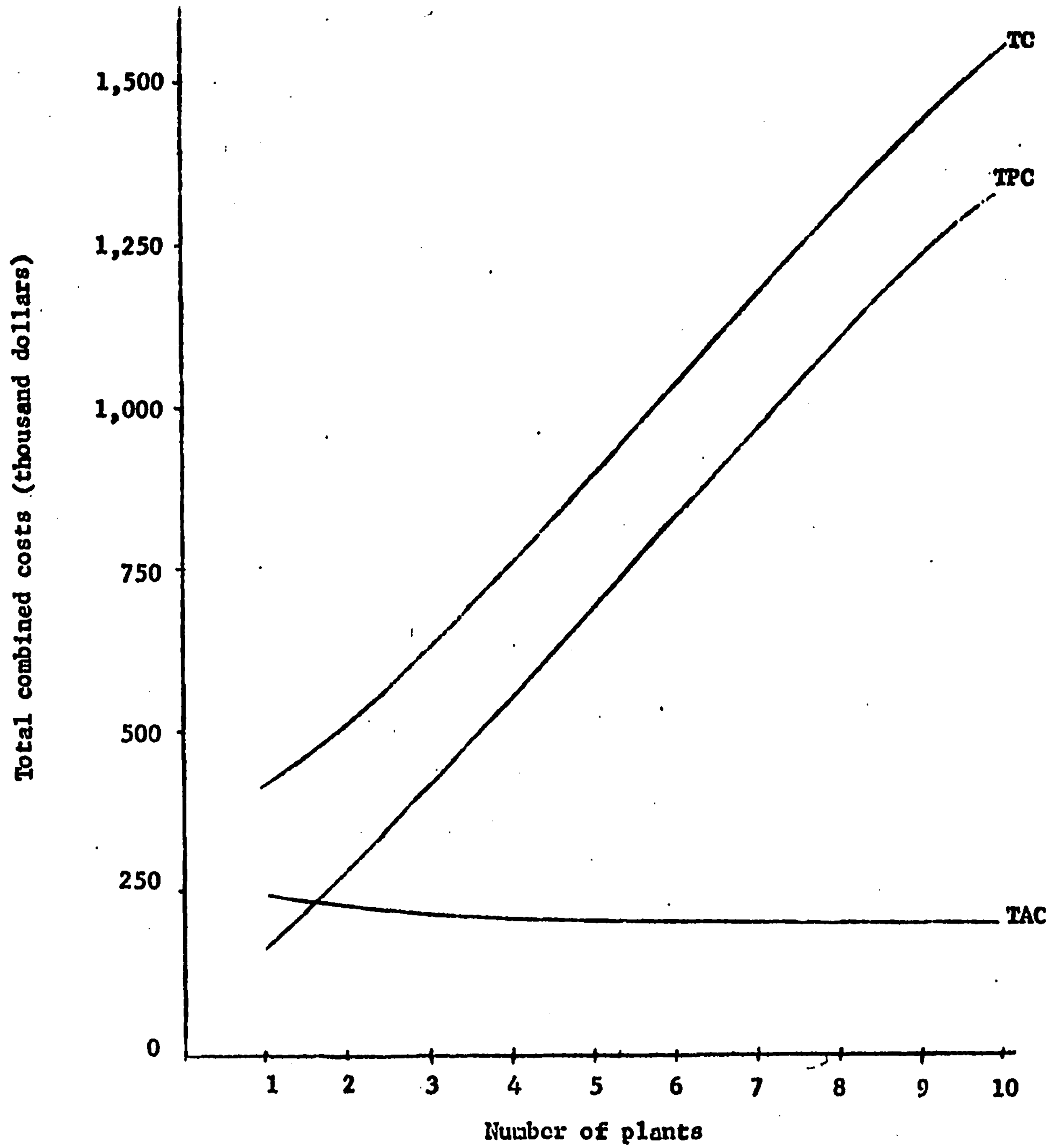

Figure 5. Case II. The Relationship of Total Processing Costs and Total Assembly Costs to Plant Numbers.

Table 26. Summary of Combined Minimum Total Assembly Cost and Minimum Processing Cost for Raw Products Available for Processing with Projected 1963 Prices Increased 10 Percent, Case II, South Central Louisiana

Number of plants	Minimum total assembly cost	Minimum processing cost	Minimum total cost
	- - - - - - - - - - - - - - - Dollars	- - - - - - - - - - - - -	
1	249,503	170,195	419,698
2	229,087	288,230	517,317
3	219,415	423,148	642,563
4	215,333	541,183	756,516
5	213,348	711,378	924,726
6	211,450	829,413	1,040,863
7	210,617	964,331	1,174,948
8	210,105	1,099,249	1,309,354
9	209,625	1,217,284	1,426,909
10	209,306	1,322,124	1,531,430

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

This study was undertaken with an overall objective of determining the optimum number, size, and location of multiple product processing establishments in the South Central Louisiana area. The area includes eight parishes, namely, Acadia, Allen, Avoyelles, Evangeline, Iberia, Lafayette, St. Landry, and St. Martin. Due to their economic importance and traditional history, the study was confined to sweet potatoes, okra, and tomatoes as the primary raw materials.

The 1963 season was selected as the period for study. Original data were collected during a vegetable growers survey conducted in August and September of 1963. Basic information used in the analysis included estimates of (1) supply functions in the various producing areas, (2) raw product supplies available in producing areas, and (3) costs of transporting supplies from each producing area to the various processing locations.

Available vegetable supplies were determined from sample estimates. The estimates included data on acreage and production of the various vegetables produced in the South Central Louisiana area.

Geographic raw product production density was selected for 25 producing origins. Since the parish unit is too aggregative for location analysis, it was necessary to develop data on a ward basis. The production density data represent the input coefficients for the general multiple product processing model.

Commodity supply functions and elasticity coefficients were obtained via an expectational supply model. Determining producer behavior in response to price changes was most important as a guide to projecting the availability of future raw products supplies. All of the estimated coefficients of supply have elastic values. Sweet potato supply elasticity ranged from 1.601 for St. Landry Parish to 3.796 in Lafayette Parish. Okra supply elasticity ranged from 3.552 in St. Landry Parish to 4.475 in St. Martin Parish. Tomatoes supply elasticity was estimated to be 4.859. All estimated supply functions were found to be statistically significant at the .01 level. As an illustration, the fitted equation for okra in South Central Louisiana was $P = 37.16 + 0.19Q$. This means that if okra price was \$37.16 per ton or less, no okra production would be forthcoming from South Central Louisiana. With a supply elasticity of 3.8, a 1 percent decrease in okra price would result in a corresponding 3.8 percent decrease in the quantity offered for sale.

The supply schedules of okra and sweet potatoes were tested in groups to determine (1) if one regression of the usual form could be fitted to all observations, and (2) if the regression coefficient for each producing area estimated the same population regression coefficient. The statistical tests revealed that (1) one regression of the usual form could not be fitted to all observations, and (2) that the same regression coefficients cannot be used for the independent variables. Thus, the difference in behavior of vegetable producers within the area was established.

Thirteen groups of sweet potato producers were selected to determine the characteristics that affect high supply elasticities. It was found that all groups supply schedules were significantly different. The relatively high elasticity of supply appeared to be associated with (1) the existence of contracts among producers, (2) a large number of below average sweet potato acreage producers, (3) the presence of below average experience producers, and (4) land ownership in the farms producing sweet potatoes.

The costs of raw product assembly represented one of the major sets of input data coefficients for the general multiple product model. Assembly cost data were collected from a trucker's survey conducted in South Central Louisiana in June of 1964. The costs associated with assembling raw materials were separated into fixed costs for loading and unloading and variable costs per mile. Standard seasons of nine and one-half weeks and sixteen weeks were assumed for okra and sweet potatoes, respectively. The computation of assembly cost coefficients was made according to economic-engineering techniques. The coefficients obtained for three truck sizes revealed that as the truck size increased, the fixed and variable costs per mile decreased. This indicated that economies of scale exist in vegetable assembling operations. The computed unit costs provided the needed assembly cost coefficients for the transfer cost matrix of the general multiple product model.

Estimated processing costs were derived from economic-engineering studies. Equations for sweet potatoes, okra, and tomatoes were incorporated into the model. Joint processing costs for the various localities were computed according to raw product allocation. The same equations were utilized for all the plant types.

The optimum number, size, and location of plants was that combination for which the sum of assembly and processing costs was as small as possible. This investigation was focused upon the following two cases: (I) the optimum combinations for seven old plants, and II the optimum patterns for ten locations, with long-run projections for potential processing locations in South Central Louisiana. It was found that in both cases, assembly and processing costs were minimized by a single processing plant located at Opelousas. The optimum size of this plant depended upon the assumed level of output.

"Sub-optimum" solutions were studied for the old plants (Case I) and for the long-run projections (Case II). The old-plant solution provides an estimate of the allocation of raw products for all seven processing localities and indicates the cost involved. Long-run projections indicated that there is potential for location of plants in the northern section of the area. Thus, if two plants were to be established in a long-run projection, Hessmer and Opelousas would represent the optimum locational pattern.

Conclusions

This study provides information which interested groups in the vegetable processing industry can use in the optimum location and/or relocation of the industry. In evaluating the results of this analysis, the specified conditions and restrictions of the analysis should be carefully considered. The supply conditions can be expected to change from one time period to another. The study illustrates the use of a tool in providing information for making adjustments to these changes in the future. Estimation of supply changes can be made on an up-to-date basis and optimum processing locations can be determined promptly with the aid of high speed electronic computers. Therefore, it would be possible to provide processors with guides for location and/or relocation of industry on a current basis.

Previous studies have not investigated the supply behavior of producers as related to the problem of optimum plant location. The findings of supply behavior appear consistent with the nature of the agricultural commodities studied. Processors should consider the possibilities of augmenting available vegetable supplies via increasing contract prices. This study provides information about the behavior of vegetable producers.

The prominence of Avoyelles Parish as a center of sweet potato production is revealed. Increased production in this area should attract the establishment of new plants. The supply estimates in this area are consistent with the locational patterns obtained in the study. However, processors should be aware of the restrictions of the study for decision making.

Additional locational factors research may be studied to aid processors in making decisions concerning the choice of plant sites. Several of the specific areas would include: (1) more data on the problem of other factors influencing location (i.e., land and labor costs, available water supply, and electrical facilities, etc.), and (2) a full investigation of the factors associated with producer responsiveness (i.e., the relative importance of cross-elasticities, land use and tenure effects,etc.). Nevertheless, it must be observed that there is a strong necessity for data to be available at the parish and ward level. The primary source of data for the study originated from a vegetable survey sample.

This study extended a mono-product model into a multiple-product processing model. Further investigation of this technique could lead to a more refined model capable of handling far broader plant location problems.

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APPENDIX A

Appendix Table 1. Sweet Potatoes: Unit Cost of Assembling Raw Products from Production Location to Existing Processing Locations, South Central Louisiana[a/]

Production Origin	Existing Processing Locations						
	Breaux Bridge	Church Point	Lafayette	New Iberia	Opelousas	St. Martinville	Ville Platte
	Dollars per Ton						
Arnaudville	2.92	3.15	3.22	3.65	2.99	3.35	3.62
Branch	3.42	2.55	3.12	3.75	3.05	3.59	3.69
Breaux Bridge	2.39	3.62	2.75	3.12	3.52	2.82	4.16
Carenco	2.92	3.09	2.62	3.25	2.99	3.09	3.62
Point Blue	4.22	3.22	3.92	4.46	3.09	4.39	3.62
Church Point	3.62	2.39	3.29	3.92	2.89	3.75	3.45
Cottonport	4.86	4.23	4.56	5.19	3.72	5.02	3.65
Hessmer	5.22	4.62	4.92	5.56	4.09	5.39	3.72
Lafayette	2.75	3.29	2.39	3.02	3.22	2.85	3.85
Lawtell	3.75	2.72	3.42	4.06	2.59	3.89	3.22
Leonville	3.15	3.22	3.45	3.92	2.72	3.62	3.35
Mansura	5.06	4.46	4.75	5.36	3.92	5.22	3.85
Oberlin	5.19	3.99	4.92	5.56	4.09	5.39	3.85
Opelousas	3.52	2.89	3.22	3.85	2.39	3.69	3.02
Osson	2.95	3.05	2.65	3.29	3.09	3.12	3.72
St. Martinville	5.60	9.57	5.74	5.03	9.29	3.32	3.35
Sunset	3.22	3.82	2.85	3.49	2.72	3.32	3.35
Ville Platte	4.16	3.45	3.85	4.69	3.02	4.32	2.39

a/ Sweet potatoes were not available for processing in the producing origins not shown in the table.

Appendix Table 2. Okra: Unit Cost of Assembling Raw Products from Production Location to Existing Processing Locations, South Central Louisiana[a]

Production origin	Existing processing locations						
	Breaux Bridge	Church Point	Lafayette	New Iberia	Opelousas	St. Martinville	Ville Platte
	Dollars per ton						
Arnaudville	3.16	3.39	3.46	3.89	3.22	3.59	3.86
Breaux Bridge	2.62	3.86	2.99	3.36	3.76	3.06	4.39
Carenco	3.16	3.32	2.85	3.49	3.22	3.32	3.85
Delcambre	3.73	4.29	3.39	2.99	4.23	3.29	4.86
Lafayette	2.99	3.52	2.62	3.26	3.46	3.09	4.09
Leonville	3.39	3.46	3.69	4.16	2.96	3.86	3.59
New Iberia	3.36	4.16	3.26	2.62	4.09	2.92	4.93
Opelousas	8.95	6.26	7.68	10.37	4.16	9.66	6.82
Osson	3.32	3.29	2.89	3.52	3.32	3.36	3.96
Scott	4.65	5.40	3.91	5.49	5.48	5.07	7.05
St. Martinville	3.06	3.99	3.09	2.92	3.93	3.50	4.56
Sunset	5.56	4.57	4.74	6.22	4.32	5.81	5.89

a/ Okra were not available for processing in the producing origins not shown in the table.

Appendix Table 3. Tomatoes: Unit Cost of Assembling Raw Products from Production Location to Existing Processing Locations, South Central Louisiana[a/]

Production origin	Existing processing locations						
	Breaux Bridge	Church Point	Lafayette	New Iberia	Opelousas	St. Martinville	Ville Platte
	Dollars per ton						
Bunkie	5.43	4.29	4.79	3.19	3.96	5.26	3.56
Point Blue	8.04	5.56	7.29	8.61	5.23	8.45	4.32
Church Point	9.38	4.13	7.96	10.66	6.26	9.95	8.67
Cottonport	9.28	8.12	8.86	10.43	6.80	10.02	6.63
Lawtell	9.95	5.55	8.53	11.23	4.98	10.52	7.68
Opelousas	8.95	6.26	7.68	10.37	4.13	9.66	6.82
Sunset	5.56	4.57	4.65	6.22	4.32	5.81	5.89
Ville Platte	4.39	3.69	4.09	4.93	3.26	4.56	2.62

a/ Tomatoes were not available for processing in the producing origins not shown in the table.

Appendix Table 4. Sweet Potatoes: Unit Costs of Assembling Raw Products from Production Location to Potential Processing Locations, South Central Louisiana[a/]

Producing origin	Potential processing locations									
	Breaux Bridge	Bunkie	Carencro	Church Point	Hessmer	Lafayette	Lawtell	Opelousas	Sunset	Ville Platte
	Dollars per ton									
Arnaudville	2.92	4.66	2.92	3.15	4.86	3.22	3.19	2.99	3.72	3.62
Branch	3.42	4.72	3.25	2.55	4.79	3.12	2.89	3.05	2.99	3.69
Breaux Bridge	2.39	5.19	2.92	3.62	5.22	2.75	3.75	3.52	3.22	4.16
Carencro	2.92	4.16	2.39	3.09	4.69	2.62	3.19	2.99	2.65	3.62
Point Blue	4.22	3.65	3.69	3.22	4.02	3.92	3.05	3.09	3.42	2.72
Church Point	3.62	4.06	3.09	2.39	4.62	3.20	2.72	2.89	2.82	3.45
Cottonport	4.86	2.72	4.32	4.23	2.75	4.56	3.92	3.72	4.06	3.65
Hessmer	5.33	2.75	4.69	4.62	2.39	4.92	4.26	4.09	4.42	3.72
Lafayette	2.75	4.56	2.62	3.29	4.92	2.39	3.42	3.22	2.85	3.85
Lawtell	3.75	4.59	3.19	2.72	4.26	3.42	2.39	2.59	2.92	3.22
Leonville	3.15	4.06	3.19	3.22	4.32	3.45	2.92	2.72	2.95	3.35
Mansure	5.06	2.92	4.52	4.46	2.55	4.75	4.09	3.92	4.26	3.85
Oberlin	5.19	4.32	4.69	3.99	4.69	4.92	3.89	4.09	4.42	3.85
Opelousas	3.52	3.72	2.99	2.89	4.09	3.22	2.59	2.39	2.72	3.02
Osson	2.95	4.42	2.82	3.05	5.12	2.65	3.29	3.09	2.79	3.72
St. Martinville	5.60	14.97	6.73	9.57	16.53	5.74	10.14	9.29	7.73	11.99
Sunset	3.22	4.22	2.65	3.82	4.42	2.85	2.92	2.72	2.39	3.35
Ville Platte	4.16	3.32	3.62	3.45	3.72	3.85	3.22	3.02	3.35	2.39

a/ Sweet potatoes were not available for processing in the producing origins not shown in the table.

Appendix Table 5. Okra: Unit Costs of Assembling Raw Products from Production Location to Potential Processing Locations, South Central Louisiana[a]

Producing origin	Potential processing locations									
	Breaux Bridge	Bunkie	Carencro	Church Point	Hessmer	Lafayette	Lawtell	Opelousas	Sunset	Ville Platte
	Dollars per ton									
Arnaudville	3.16	4.89	3.86	3.39	5.09	3.46	3.42	3.22	3.96	3.86
Breaux Bridge	2.62	5.43	4.53	3.86	5.46	2.99	3.99	3.76	3.46	4.39
Carencro	3.16	4.39	2.62	3.32	4.93	2.85	3.42	3.22	2.89	3.85
Delcambre	3.73	5.43	3.63	4.29	5.83	3.39	4.43	4.23	3.89	4.86
Lafayette	2.99	2.99	2.86	3.52	5.16	2.62	3.66	3.46	3.09	4.09
Leonville	3.39	4.29	3.42	3.46	4.56	3.69	3.16	2.96	3.19	3.59
New Iberia	3.36	5.43	3.49	4.16	5.80	3.26	4.29	4.09	3.73	4.93
Opelousas	8.95	9.81	6.68	6.26	11.37	7.68	4.98	4.16	5.55	6.82
Osson	3.32	4.66	3.06	3.29	5.36	2.89	3.52	3.32	3.02	3.96
Scott	4.65	8.78	4.32	5.40	10.02	3.91	5.97	5.48	4.74	7.05
St. Martinville	3.06	5.26	3.32	3.99	5.63	3.09	4.13	3.93	3.89	4.56
Sunset	5.56	8.04	4.16	4.57	8.53	4.74	4.82	4.32	3.50	5.89

a/ Okra were not available for processing in the producing origins not shown in the table.

Appendix Table 6. Tomatoes: Unit Costs of Assembling Raw Products from Production Location to Potential Processing Locations, South Central Louisiana[a]

Producing origin	Breaux Bridge	Bunkie	Carencro	Church Point	Hessmer	Lafayette	Lawtell	Opelousas	Sunset	Ville Platte
	Potential processing locations									
	Dollars per ton									
Bunkie	5.43	2.62	4.39	4.29	2.99	4.79	4.83	3.96	4.46	3.56
Point Blue	8.04	6.63	6.72	5.56	7.54	7.29	5.15	5.23	6.06	4.32
Church Point	9.38	11.23	7.11	4.13	13.64	7.96	5.55	6.26	5.97	8.67
Cottonport	9.28	4.32	8.28	8.12	4.41	8.86	7.29	6.80	7.62	6.63
Lawtell	9.95	13.50	7.53	5.55	12.08	8.53	4.13	4.98	6.40	7.68
Opelousas	8.95	9.81	6.68	6.26	11.37	7.68	4.98	4.13	5.55	6.82
Sunset	5.56	9.31	4.16	4.57	8.53	4.65	4.82	4.32	3.50	5.89
Ville Platte	4.39	3.56	3.86	3.69	3.96	4.09	3.46	3.26	3.59	2.62

a/ Tomatoes were not available for processing in the producing origins not shown in the table.

Appendix Table 7. Case I. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocations of Raw Products Available for Processing, Increasing 1963 Prices by 10 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		Dollars			Tons		
1	Opelousas	249,503	170,195	419,698	72,624	10,713	1,557
2	Lafayette	239,830	305,113	544,943	6,963	7,551	
	Opelousas				65,661	3,162	1,557
3	Lafayette	234,730	423,148	657,878	6,963	7,551	
	Opelousas				43,968	3,162	370
	Ville Platte				21,693		1,187
4	Church Point	230,766	541,183	771,949	8,494		74
	Lafayette				6,963	7,551	
	Opelousas				34,474	3,162	296
	Ville Platte				22,693		1,187
5	Church Point	229,427	711,378	940,805	8,494		74
	Lafayette				6,860	3,417	
	New Iberia				103	4,134	297
	Opelousas				35,474	3,162	296
	Ville Platte				21,693		890

(Continued)

Appendix Table 7. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products		
					Sweet potatoes	Okra	Tomatoes
		---------------	Dollars	---------------	-------------	Tons	------------
6	Breaux Bridge	228,680	846,296	1,074,976	4,214	3,225	
	Church Point				8,494		74
	Lafayette				6,378	2,766	
	New Iberia				103	4,134	297
	Opelousas				31,742	588	296
	Ville Platte				21,693		890
7	Breaux Bridge	228,561	889,914	1,118,475	4,214	3,225	
	Church Point				8,494		74
	Lafayette				6,378	2,766	
	New Iberia					4,134	297
	Opelousas				31,742	588	296
	St. Martinville				103		
	Ville Platte				21,693		890

Appendix Table 8. Case I. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocations of Raw Products Available for Processing, Increasing 1963 Prices by 20 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		--------------Dollars	---------------	---------------	------------Tons	------------	------------
1	Opelousas	299,223	170,195	469,418	85,612	13,859	2,064
2	Lafayette	286,780	305,113	591,893	8,879	9,784	
	Opelousas				76,733	4,075	2,064
3	Lafayette	280,723	423,148	703,871	8,879	9,784	
	Opelousas				51,730	4,075	490
	Ville Platte				25,363		1,574
4	Church Point	276,177	541,183	817,360	9,686		98
	Lafayette				8,879	9,784	
	Opelousas				42,684	4,075	392
	Ville Platte				25,363		1,574
5	Church Point	274,439	711,378	985,817	9,686		98
	Lafayette				8,748	4,400	
	New Iberia				131	5,384	394
	Opelousas				41,684	4,075	392
	Ville Platte				25,363		1,180

(Continued)

Appendix Table 8. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---------------	Dollars	---------------	-------------	Tons	------------
6	Breaux Bridge	273,475	846,296	1,119,771	5,368	4,221	
	Church Point				9,686		98
	Lafayette				8,134	3,548	
	New Iberia				131	5,411	394
	Opelousas				36,930	679	392
	Ville Platte				25,363		1,180
7	Breaux Bridge	273,324	889,914	1,163,328	5,368	4,221	
	Church Point				9,686		98
	Lafayette				8,134	3,548	
	New Iberia					5,411	394
	Opelousas				36,930	679	392
	St. Martinville				131		
	Ville Platte				25,363		1,180

Appendix Table 9. Case I. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocations of Raw Products Available for Processing, Increasing 1963 Prices by 30 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---------------Dollars---------------			-------------Tons------------		
1	Opelousas	349,041	170,195	519,236	98,599	17,028	2,571
2	Lafayette	333,828	308,113	641,941	10,795	12,012	
	Opelousas				87,804	5,016	2,571
3	Lafayette	326,814	426,148	752,962	10,795	12,012	
	Opelousas				58,773	5,016	610
	Ville Platte				29,031		1,961
4	Church Point	321,685	544,183	865,868	10,878		122
	Lafayette				10,795	12,012	
	Opelousas				47,895	5,016	488
	Ville Platte				29,031		1,961
5	Church Point	319,548	714,378	1,033,926	10,878		122
	Lafayette				10,635	5,378	
	New Iberia				160	6,643	491
	Opelousas				47,895	5,016	488
	Ville Platte				29,031		1,470

(Continued)

Appendix Table 9. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		--------------Dollars--------------			------------Tons------------		
6	Breaux Bridge	318,367	849,296	1,167,663	6,522	5,219	
	Church Point				10,878		122
	Lafayette				9,889	4,324	
	New Iberia				160	6,634	491
	Opelousas				42,119	851	488
	Ville Platte				29,031		1,470
7	Breaux Bridge	318,182	889,914	1,208,096	6,522	5,219	
	Church Point				10,878		122
	Lafayette				9,889	4,324	
	New Iberia					6,634	491
	Opelousas				42,119	851	488
	St. Martinville				160		
	Ville Platte				29,031		1,470

Appendix Table 10. Case I. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocations of Raw Products Available for Processing, Decreasing 1963 Prices by 10 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---------------	Dollars	---------------	------------	Tons	------------
1	Opelousas	149,779	170,195	319,974	46,653	4,351	543
2	Lafayette	145,644	305,113	450,757	3,132	3,103	
	Opelousas				43,521	1,248	543
3	Lafayette	142,457	423,148	565,605	3,132	3,103	
	Opelousas				29,164	1,248	130
	Ville Platte				14,357		413
4	Church Point	139,659	541,183	680,842	6,109		26
	Lafayette				3,132	3,103	
	Opelousas				23,055	1,248	104
	Ville Platte				14,357		413
5	Church Point	139,117	711,378	850,495	6,109		26
	Lafayette				3,086	1,469	
	New Iberia				46	1,634	103
	Opelousas				23,055	1,248	104
	Ville Platte				14,357		310

(Continued)

Appendix Table 10. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---------------	Dollars	---------------	-------------	Tons	-------------
6	Breaux Bridge	138,804	846,296	985,100	1,903	1,230	
	Church Point				6,109		26
	Lafayette				2,869	1,221	
	New Iberia				46	1,634	103
	Opelousas				21,369	266	104
	Ville Platte				14,357		310
7	Breaux Bridge	138,751	889,914	1,028,665	1,903	1,230	
	Church Point				6,109		26
	Lafayette				2,869	1,221	
	New Iberia					1,634	103
	Opelousas				21,369	266	104
	St. Martinville				46		
	Ville Platte				14,357		310

Appendix Table 11. Case I. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocations of Raw Products Available for Processing, Decreasing 1963 Prices by 20 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		--------------Dollars--------------			------------Tons------------		
1	Opelousas	100,013	170,195	270,208	33,664	1,191	38
2	Church Point	97,716	340,390	438,106	5,860	108	2
	Opelousas				27,804	1,083	36
3	Church Point	95,554	510,585	606,139	5,210	108	2
	Opelousas				17,767	1,083	10
	Ville Platte				10,687		26
4	Church Point	94,186	541,183	635,369	4,918		2
	Lafayette				1,216	886	
	Opelousas				16,843	305	10
	Ville Platte				10,687		26
5	Church Point	94,043	728,261	822,304	4,918		2
	Lafayette				1,198	502	
	New Iberia				18	384	6
	Opelousas				16,180	304	10
	Ville Platte				10,687		20

(Continued)

Appendix Table 11. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---------------Dollars---------------			-------------Tons------------		
6	Breaux Bridge	93,948	846,296	940,244	748	233	
	Church Point				4,918		2
	Lafayette				1,113	455	
	New Iberia				18	384	6
	Opelousas				16,180	119	10
	Ville Platte				10,687		20
7	Breaux Bridge	93,927	889,914	983,841	748	233	
	Church Point				4,918		2
	Lafayette				1,113	455	
	New Iberia					384	6
	Opelousas				16,180	119	10
	St. Martinville				18		
	Ville Platte				10,687		20

Appendix Table 12. Case I. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocations of Raw Products Available for Processing, Decreasing 1963 Prices by 30 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		Dollars			Tons		
1	Opelousas	61,570	104,840	166,410	21,737		
2	Church Point	59,842	209,680	329,364	4,290		
	Opelousas				17,447		
3	Breaux Bridge	58,449	314,520	372,969			
	Church Point				4,290		
	Opelousas				17,447		
4	Breaux Bridge	58,449	419,360	477,809			
	Church Point				4,290		
	Lafayette						
	Opelousas				17,447		
5	Breaux Bridge	58,449	524,200	582,649			
	Church Point				4,290		
	Lafayette						
	New Iberia						
	Opelousas				17,447		

(Continued)

Appendix Table 12. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		--------------Dollars--------------			-------------Tons------------		
6	Breaux Bridge	58,449	629,040	745,938			
	Church Point				3,726		
	Lafayette						
	New Iberia						
	Opelousas				10,993		
	Ville Platte				7,018		
7	Breaux Bridge	58,449	733,880	792,329			
	Church Point				3,726		
	Lafayette						
	New Iberia						
	Opelousas				10,993		
	St. Martinville						
	Ville Platte				7,018		

Appendix Table 13. Case II. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocation of Raw Products Available for Processing, 1963 Price Levels, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		Dollars			Tons		
1	Opelousas	199,638	170,195	369,833	59,646	7,526	1,050
2	Hessmer	182,769	288,230	470,999	7,449		350
	Opelousas				52,197	7,526	700
3	Hessmer	175,861	423,148	599,009	13,679		350
	Lafayette				5,050	5,333	
	Opelousas				35,867	2,193	700
4	Church Point	172,378	541,183	713,561	8,427		50
	Hessmer				13,679		350
	Lafayette				5,050	5,333	
	Opelousas				32,490	2,193	650
5	Church Point	170,725	659,218	829,943	8,427		50
	Hessmer				13,679		350
	Lafayette				5,050	5,333	
	Opelousas				27,592	2,193	550
	Sunset				4,898		100

(Continued)

Appendix Table 13. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw product		
					Sweet potatoes	Okra	Tomatoes
		--------------Dollars--------------			------------Tons------------		
6	Church Point	169,226	829,413	998,639	7,302		50
	Hessmer				13,679		350
	Lafayette				5,050	5,333	
	Opelousas				24,368	2,205	100
	Sunset				4,898	168	100
	Ville Platte				4,349		450
7	Breaux Bridge	168,636	964,331	1,132,967	3,134	4,096	
	Church Point				7,302		50
	Hessmer				13,679		350
	Lafayette				4,625	3,015	
	Opelousas				21,659	247	100
	Sunset				4,898	168	100
	Ville Platte				4,349		450
8	Breaux Bridge	168,233	1,082,366	1,250,599	3,134	4,096	
	Church Point				7,302		50
	Hessmer				13,679		350
	Lafayette				4,625	3,015	
	Lawtell				2,030		50
	Opelousas				19,629	247	50
	Sunset				4,898	168	100
	Ville Platte				4,349		450

(Continued)

Appendix Table 13. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---Dollars---			---Tons---		
9	Breaux Bridge	167,862	1,217,284	1,385,146	3,134	4,096	
	Carencro				1,375	418	
	Church Point				7,302		50
	Hessmer				13,679		350
	Lafayette				3,250	2,597	
	Lawtell				2,030		50
	Opelousas				19,629	247	50
	Sunset				4,898	168	100
	Ville Platte				4,349		450
10	Breaux Bridge	167,615	1,335,319	1,502,934	3,134	4,096	
	Bunkie				6,225		350
	Carencro				1,375	418	
	Church Point				7,302		50
	Hessmer				7,454		
	Lafayette				3,250	2,597	
	Lawtell				2,030		50
	Opelousas				19,629	247	50
	Sunset				4,898	168	100
	Ville Platte				4,349		450

Appendix Table 14. Case II. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocation of Raw Products Available for Processing Increasing 1963 Prices by 20 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products		
					Sweet potatoes	Okra	Tomatoes
		---------Dollars---------			---------Tons---------		
1	Opelousas	299,223	170,195	469,418	85,612	13,859	2,064
2	Hessmer	275,251	288,230	563,481	19,214		688
	Opelousas				66,398	13,859	1,376
3	Hessmer	262,809	423,148	685,957	19,214		688
	Lafayette				8,879	9,784	
	Opelousas				57,519	4,075	1,376
4	Church Point	258,128	541,183	799,311	11,185		98
	Hessmer				19,214		688
	Lafayette				8,879	9,784	
	Opelousas				46,334	4,075	1,278
5	Church Point	255,832	659,218	914,750	9,686		98
	Hessmer				19,214		688
	Lafayette				8,879	9,784	
	Opelousas				41,684	4,075	392
	Ville Platte				6,149		886

(Continued)

Appendix Table 14. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		Dollars			Tons		
6	Church Point	253,558	829,413	1,082,971	9,686		98
	Hessmer				19,214		688
	Lafayette				8,879	9,784	
	Opelousas				35,218	3,791	196
	Sunset				6,466	284	196
	Ville Platte				6,149		886
7	Breaux Bridge	252,482	964,331	1,216,813	5,885	7,761	
	Church Point				9,686		98
	Hessmer				19,214		688
	Lafayette				8,134	5,392	
	Opelousas				30,464	422	196
	Sunset				6,466	284	196
	Ville Platte				6,149		886
8	Breaux Bridge	251,828	1,099,249	1,351,721	5,499	7,761	
	Carencro				2,419	739	
	Church Point				9,686		98
	Hessmer				19,214		688
	Lafayette				5,715	4,653	
	Opelousas				30,464	422	196
	Sunset				6,466	284	196
	Ville Platte				6,149		886

(Continued)

Appendix Table 14. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products		
					Sweet potatoes	Okra	Tomatoes
		---------------Dollars---------------			-------------Tons------------		
9	Breaux Bridge	251,270	1,217,284	1,468,554	5,499	7,761	
	Carencro				2,419	739	
	Church Point				9,686		98
	Hessmer				19,214		688
	Lafayette				5,715	4,653	
	Lawtell				2,680		98
	Opelousas				27,784	422	98
	Sunset				6,466	284	196
	Ville Platte				6,149		886
10	Breaux Bridge	250,879	1,308,929	1,559,808	5,499	7,761	
	Bunkie				8,746		688
	Carencro				2,419	739	
	Church Point				9,686		
	Hessmer				10,468		
	Lafayette				5,715	4,653	
	Lawtell				2,680		98
	Opelousas				27,784	422	98
	Sunset				6,466	284	196
	Ville Platte				6,149		886

Appendix Table 15. Case II. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocation of Raw Products Available for Processing Increasing 1963 Prices by 30 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---Dollars---			---Tons---		
1	Opelousas	349,041	170,195	489,236	98,599	17,028	2,571
2	Hessmer	321,516	288,230	609,746	21,983		857
	Opelousas				76,616	17,028	1,714
3	Hessmer	306,302	423,148	729,450	21,983		857
	Lafayette				9,095	12,012	
	Opelousas				67,521	5,016	1,714
4	Church Point	301,022	541,183	842,205	12,564		122
	Hessmer				21,983		857
	Lafayette				10,795	12,012	
	Opelousas				53,257	5,016	1,592
5	Church Point	298,328	659,218	957,546	10,878		122
	Hessmer				21,983		857
	Lafayette				10,795	12,012	
	Opelousas				47,895	5,016	488
	Ville Platte				7,048		1,104

(Continued)

Appendix Table 15. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---Dollars---			---Tons---		
6	Church Point	295,743	829,413	1,125,156	10,878		122
	Hessmer				21,983		857
	Lafayette				10,795	12,012	
	Opelousas				40,645	4,674	244
	Sunset				7,250	342	244
	Ville Platte				7,048		1,104
7	Breaux Bridge	294,423	964,331	1,258,754	6,682	9,595	
	Church Point				10,878		122
	Hessmer				21,983		857
	Lafayette				9,889	6,582	
	Opelousas				34,869	509	244
	Sunset				7,250	342	244
	Ville Platte				7,048		1,104
8	Breaux Bridge	293,628	1,099,249	1,392,877	6,682	9,595	
	Carencro				2,941	900	
	Church Point				10,878		122
	Hessmer				21,983		857
	Lafayette				6,948	5,682	
	Opelousas				34,869	509	244
	Sunset				7,250	342	244
	Ville Platte				7,048		1,104

(Continued)

Appendix Table 15. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products		
					Sweet potatoes	Okra	Tomatoes
		--------------Dollars--------------			------------Tons-----------		
9	Breaux Bridge	292,994	1,217,284	1,510,278	6,682	9,595	
	Carencro				2,941	900	
	Church Point				10,878		122
	Hessmer				21,983		857
	Lafayette				6,948	5,682	
	Lawtell				3,005		122
	Opelousas				31,864	509	122
	Sunset				7,250	342	244
	Ville Platte				7,048		1,104
10	Breaux Bridge	292,530	1,322,124	1,614,654	6,682	9,595	
	Bunkie				10,006		857
	Carencro				2,941	900	
	Church Point				10,878		122
	Hessmer				11,977		
	Lafayette				6,948	5,682	
	Lawtell				3,005		122
	Opelousas				31,864	509	122
	Sunset				7,250	342	244
	Ville Platte				7,048		1,104

Appendix Table 16. Case II. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocation of Raw Products Available for Processing Decreasing 1963 Prices by 10 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		----Dollars----			----Tons----		
1	Opelousas	149,779	170,195	319,974	46,653	4,351	543
2	Hessmer	136,466	288,230	424,696	10,908		181
	Opelousas				35,745	4,351	362
3	Hessmer	132,332	423,148	555,480	10,908		181
	Lafayette				3,132	3,103	
	Opelousas				32,613	1,248	362
4	Church Point	129,449	541,183	670,632	7,047		26
	Hessmer				10,908		181
	Lafayette				3,132	3,103	
	Opelousas				25,566	1,248	336
5	Church Point	128,109	711,378	839,487	7,047		26
	Hessmer				10,908		181
	Lafayette				3,132	3,103	
	Opelousas				21,452	1,141	284
	Sunset				4,114	107	52

(Continued)

Appendix Table 16. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Optimum allocation raw products: Okra	Optimum allocation raw products: Tomatoes
		---Dollars---			---Tons---		
6	Church Point	127,009	829,413	956,422	6,109		26
	Hessmer				10,908		181
	Lafayette				3,132	3,103	
	Opelousas				18,941	1,141	52
	Sunset				4,114	107	52
	Ville Platte				3,449		232
7	Breaux Bridge	126,663	964,331	1,090,994	1,949	2,262	
	Church Point				6,109		26
	Hessmer				10,908		181
	Lafayette				2,869	1,823	
	Opelousas				17,255	159	52
	Sunset				4,114	107	52
	Ville Platte				3,449		232
8	Breaux Bridge	126,336	1,082,366	1,208,702	1,949	2,262	
	Church Point				6,109		26
	Hessmer				10,908		181
	Lafayette				2,869	1,823	
	Lawtell				1,705		26
	Opelousas				15,550	159	26
	Sunset				4,114	107	52
	Ville Platte				3,449		232

(Continued)

Appendix Table 16. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products		
					Sweet potatoes	Okra	Tomatoes
		--------------Dollars--------------			------------Tons------------		
9	Breaux Bridge	126,106	1,200,401	1,326,507	1,949	2,262	
	Carencro				854	257	
	Church Point				6,109		26
	Hessmer				10,908		181
	Lafayette				2,015	1,566	
	Lawtell				1,705		26
	Opelousas				15,550	159	26
	Sunset				4,114	107	52
	Ville Platte				3,449		232
10	Breaux Bridge	125,932	1,322,124	1,448,056	1,949	2,262	
	Bunkie				4,964		181
	Carencro				854	257	
	Church Point				6,109		26
	Hessmer				5,944		
	Lafayette				2,015	1,566	
	Lawtell				1,705		26
	Opelousas				15,550	159	26
	Sunset				4,114	107	52
	Ville Platte				3,449		232

Appendix Table 17. Case II. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocation of Raw Products Available for Processing, Decreasing 1963 Prices by 20 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products		
					Sweet potatoes	Okra	Tomatoes
		--------------Dollars--------------			------------Tons------------		
1	Opelousas	100,013	170,195	270,208	33,664	1,191	38
2	Hessmer	90,254	288,230	378,484	8,139		6
	Opelousas				25,525	1,191	32
3	Church Point	87,957	458,425	546,382	5,860	108	2
	Hessmer				8,139		12
	Opelousas				19,665	1,083	24
4	Church Point	86,303	576,460	662,763	5,668		2
	Hessmer				139		12
	Opelousas				15,311	257	20
	Sunset				4,546	934	4
5	Church Point	85,562	711,378	796,940	5,668		2
	Hessmer				8,139		12
	Lafayette				1,216	886	
	Opelousas				15,311	257	20
	Sunset				3,330	48	4

(Continued)

Appendix Table 17. (Continued)

Number of plants	Optimum processing locations	Minimum assembly costs	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---Dollars---			---Tons---		
6	Church Point	84,860	829,413	914,273	4,918		2
	Hessmer				8,139		12
	Lafayette				1,216	886	
	Opelousas				13,513	257	6
	Sunset				3,330	48	4
	Ville Platte				2,548		14
7	Church Point	84,611	947,448	1,032,058	4,918		2
	Hessmer				8,139		12
	Lafayette				1,216	886	
	Lawtell				1,378		2
	Opelousas				12,135	257	4
	Sunset				3,330	48	4
	Ville Platte				2,548		14
8	Carencro	84,480	1,082,366	1,166,846	994	96	
	Church Point				4,918		2
	Hessmer				8,139		12
	Lafayette				885	790	
	Lawtell				1,378		2
	Opelousas				11,472	257	4
	Sunset				3,330	48	4
	Ville Platte				2,548		14

(Continued)

Appendix Table 17. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products		
					Sweet potatoes	Okra	Tomatoes
		---------------Dollars---------------			-------------Tons------------		
9	Bunkie	84,378	1,187,206	1,271,584	3,704		12
	Carencro				994	96	
	Church Point				4,918		2
	Hessmer				4,435		
	Lafayette				995	790	
	Lawtell				1,378		2
	Opelousas				11,472	257	4
	Sunset				3,330	48	4
	Ville Platte				2,548		14
10	Breaux Bridge	84,317	1,322,124	1,406,441	766		
	Bunkie				3,704		12
	Carencro				331		
	Church Point				4,918		2
	Hessmer				4,435		
	Lafayette				782		
	Lawtell				1,378		2
	Opelousas				11,472		4
	Sunset				3,330		4
	Ville Platte				2,548		14

Appendix Table 18. Case II. Minimum Assembly and Processing Costs, Optimum Processing Locations and Optimum Allocation of Raw Products Available for Processing, Decreasing 1963 Prices by 30 Percent, South Central Louisiana

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---Dollars---			---Tons---		
1	Opelousas	61,570	104,840	166,410	21,737		
2	Hessmer	55,145	209,680	264,825	5,368		
	Opelousas				16,369		
3	Church Point	53,418	314,520	367,938	4,290		
	Hessmer				5,368		
	Opelousas				12,079		
4	Church Point	52,662	419,360	472,022	4,290		
	Hessmer				5,368		
	Opelousas				9,534		
	Sunset				2,545		
5	Church Point	52,229	524,200	576,429	3,726		
	Hessmer				5,368		
	Opelousas				8,448		
	Sunset				2,545		
	Ville Platte				1,650		

(Continued)

Appendix Table 18. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		---Dollars---			---Tons---		
6	Church Point	52,039	629,040	681,079	3,726		
	Hessmer				5,368		
	Lawtell				1,055		
	Opelousas				7,393		
	Sunset				2,545		
	Ville Platte				1,650		
7	Bunkie	51,973	733,880	785,853	2,443		
	Church Point				3,726		
	Hessmer				2,925		
	Lawtell				1,055		
	Opelousas				7,393		
	Sunset				2,545		
	Ville Platte				1,650		
8	Breaux Bridge	51,973	838,720	890,693			
	Bunkie				2,443		
	Church Point				3,726		
	Hessmer				2,925		
	Lawtell				1,055		
	Opelousas				7,393		
	Sunset				2,545		
	Ville Platte				1,650		

(Continued)

Appendix Table 18. (Continued)

Number of plants	Optimum processing locations	Minimum assembly cost	Minimum processing cost	Minimum total cost	Optimum allocation raw products: Sweet potatoes	Okra	Tomatoes
		Dollars			Tons		
9	Breaux Bridge	51,973	943,560	995,533			
	Bunkie				2,443		
	Church Point				3,726		
	Hessmer				2,925		
	Lafayette						
	Lawtell				1,055		
	Opelousas				7,393		
	Sunset				2,545		
	Ville Platte				1,650		
10	Breaux Bridge	51,973	1,048,400	1,100,373			
	Bunkie				2,443		
	Carencro						
	Church Point				3,726		
	Hessmer				2,925		
	Lafayette						
	Lawtell				1,055		
	Opelousas				7,393		
	Sunset				2,545		
	Ville Platte				1,650		

APPENDIX B

Louisiana State University
Department of Agricultural Economics
and Agribusiness
Baton Rouge 3, Louisiana

Budget Bureau No. 40 - 6387
Approval Expires 12 - 31 - 63

PRESENT AND POTENTIAL VEGETABLE SUPPLIES
AVAILABLE FOR PROCESSING, SOUTH CENTRAL LOUISIANA

Personal Interview

______________ ______________ ______________
Farm Number Parish Year

1. Location of farm ______________________________
____

______________ ______________
Date schedule taken Enumerator

2. Operator's name ______________________________

Operator's address ______________________________
____

Years experience in vegetable growing ______________

Highest grade of school completed 0 1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 or more

3. Land operated in 1963

Land	Acres	Vegetable acreage	Conditions of tenure
Owned			XXXXXXXXX
Part-owner			
Cash-rent			
Share-crop			
Total land operated			

4. Vegetables: Producing in 1963 (Estimate):

Vegetables	Acreage Harvested: Fresh	Acreage Harvested: Processing	Acreage Harvested: Total	Expected yield per acre	Total production	Prices: Fresh: Unit	Prices: Fresh: Price	Prices: Processing: Unit	Prices: Processing: Price
Sweet potatoes									
Okra									
Squash									
Total acres vegetables									

5. Vegetables: Produced in 1962:

Vegetables	Acreage Harvested: Fresh	Acreage Harvested: Processing	Acreage Harvested: Total	Yield per acre	Total production	Prices Received: Fresh: Unit	Prices Received: Fresh: Price	Prices Received: Processing: Unit	Prices Received: Processing: Price
Sweet potatoes									
Okra									
Squash									
Total acres vegetables									

6. Grower-Processor contracts 1963:

A. Do you have a contract with a processor?_____ Fresh market?______

B. If yes, how many acres are you producing under contract this year? ______

C. Please indicate current contract prices?

Vegetables	Unit	Contract price	Nature and amount of quality discounts and/or premiums

D. Name of processor(s) ______________ ______________

______________ ______________

E. Aid received:

	Processor 1	Processor 2	Processor 3
1. Per cent seed			
2. Per cent fertilizer			
3. Technical assistance (specify) ______________			
4. Other (specify) ______________ ______________			

F. Does your contract specify the:

	Processor 1	Processor 2	Processor 3
1. Seed Variety			
2. Date of planting			
3. Date of harvest			
4. Date of delivery			
5. Method of delivery			

G. Transportation of raw materials:

	Processor 1	Processor 2	Processor 3
1. Do you haul your crop?			
2. Does the processor haul your crop?			
3. Others ______ ______			
4. Miles hauled			

7. Usual planting and harvesting dates:

Vegetables	Usual planting date	Beginning harvest date	Ending harvest date
Sweet potatoes			
Okra			
Squash			

8. Long range plans:

Do you expect to produce vegetables in 1965: Yes _____ No ______
If no, explain why? ______________________________

NOTE: Answer 9 and 10 only if a yes answer to 8.

9. Supply response:

A. Price increase:
How many acres of processing vegetables would you grow in 1965 if the prices received were to increase (over current average prices) by the following amounts:

Vegetables	Unit of sale	1963 Average price	1965 acreage if prices increase 10%	20%	30%
Sweet potatoes					
Okra					
Squash					

B. Price decrease:
How many acres of processing vegetables would you grow in 1965 if the prices received were to decrease from 1963 average prices by the following amounts:

Vegetables	Unit of sale	1963 Average price	1965 acreage if prices decrease 10%	20%	30%
Sweet potatoes					
Okra					
Squash					

10. A. With your present labor supply, what would be your maximum vegetable acreage with mechanical harvesting of sweet potatoes:

Vegetables	Acreage		
Sweet potatoes			

B. With your present labor supply what would be your maximum vegetable acreage without mechanical harvesting of sweet potatoes:

Vegetables	Acreage		
Sweet potatoes			

11. Additional comments:

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Department of Agricultural Economics and Agribusiness
Louisiana State University
Baton Rouge, Louisiana

ASSEMBLY COST STUDY

Schedule Number ______________
Enumerator ______________________ Date ______________________

1. Operator's Name ____
   Operator's Address ____
   Town ______________________ Parish ______________

2. General Information:
   Years experience in trucking business ______________
   Truck Ownership: Number __________ Rented ______________
   Private __________ Company owned ________
   Leased __________

   Crops Hauled: Days Used During Year

Crops Hauled	Days Used During Year
1. ______________________	____________
2. ______________________	____________
3. ______________________	____________
4. ______________________	____________
5. ______________________	____________

3. Truck Description:

	Year-Make	Ton-nage	Raw Product Capacity (Tons)	Original Price	Replacement Costs	Estimated Useful Life Years	Average Hauling Speed MPH
(a)							
(b)							
(c)							

4. Overhead Costs-Yearly:

	Licenses	Registration	Insurance	Interest of Investment	Cost of Storage	Depreciation
(a)						
(b)						
(c)						

5. Operating Costs:

	Fuel MPH	Fuel Costs/ gal.	Maintenance Services	Repairs Per Year	Tires and Tubes	Other
(a)	______	______	______	______	______	______
(b)	______	______	______	______	______	______
(c)	______	______	______	______	______	______

6. Labor Expenses:
   (a) Loading:
      1. Average time for loading ________ Size of load ________
      2. Persons used in loading ________ Wage per hour ________
      3. Does driver help load ________ Wage per hour ________

   (b) Unloading:
      1. Average time for unloading ______
      2. Persons used for unloading ______ Wage per hour ________
      3. Does driver help unload ________ Wage per hour ________

   (c) Average distance of hauling trip ____________
      Average time for hauling trip ____________
      Days per week performed ____________
      Length of crop season, by commodities:
      1. ____________
      2. ____________
      3. ____________

7. Commercial Trucking:
   1. Name from whom you hire truck ____________
      Address ____________
   2. Rate per ton charged ____________
      1. ____________
      2. ____________
      3. ____________
   3. Average tons hauled per trip ____________
   4. Driver's wages per 8 hour day ________ Premium wages ______
   5. Number of workmen ____________ Wages ________
   6. Distance traveled per day ____________
   7. Speed miles per hour ____________
   8. (a) Number of stops to pick up raw product ________
      (b) Average volume per pick up ____________
      (c) Average time per stop ____________
   9. Miles traveled per year ____________

VITA

Jose Edgar Lopez was born on March 19, 1939, in San Salvador, El Salvador. He attended Externado de San Jose High School in San Salvador and received the Official School Degree in October, 1956.

He enrolled in the English Language Institute at the University of Florida, Gainesville, Florida on July 1, 1957. He was awarded a certificate of completion on August 30, 1957.

In September 1957, he entered Clemson University where he began undergraduate studies in Agronomy. He was awarded a Bachelor of Science degree on June 4, 1961.

In June 1961, he began graduate studies in Agronomy at the University of Georgia and received the Master of Science degree on June 1, 1963.

He enrolled and accepted a graduate research assistantship in the Department of Agricultural Economics and Agribusiness at Louisiana State University in February 1963. He is now a candidate for the Ph.D. degree in Agricultural Economics.

EXAMINATION AND THESIS REPORT

Candidate: Jose Edgar Lopez

Major Field: Agricultural Economics

Title of Thesis: Optimum Number, Size, and Location of Multiple Product Vegetable Processing Establishments in South Central Louisiana

Approved:

Jerry M. Law
Major Professor and Chairman

Max Goodrich
Dean of the Graduate School

EXAMINING COMMITTEE:

Lonnie L. Fielder, Jr.

Robert H. Flammang

Joe R. Campbell

J. H. Wiegmann

Date of Examination:

May 11, 1966